



**4.5 Homeostasis and Response  
Foundation / Higher**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **278 minutes**

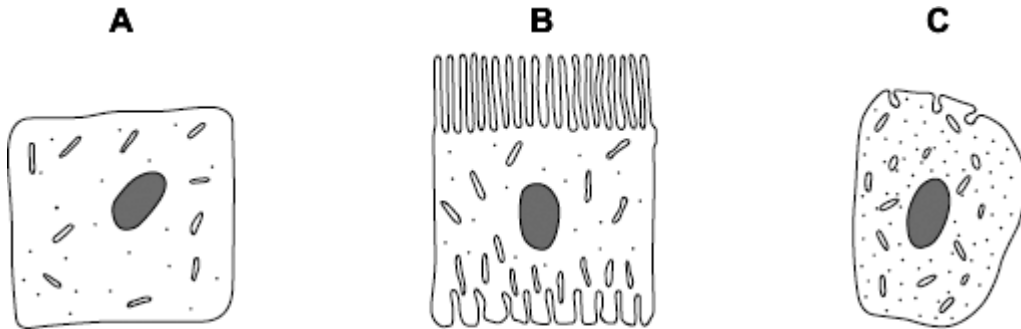
Marks: **272 marks**

Comments:

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**Q1.**

Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



**Key**  
- Mitochondrion  
· Ribosome

- (a) Which cell, **A**, **B** or **C**, appears to have adaptations to increase diffusion into or out of

the cell?

Give **one** reason for your choice.

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(1)

- (b) (i) Cell **C** is found in the pancreas.

Name **one** useful substance produced by the pancreas.

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(1)

- (ii) Use information from the diagram to explain how cell **C** is adapted for producing this substance.

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(2)

(Total 4 marks)

**Q2.**

Diabetes is a disease in which a person's blood glucose concentration rises to higher levels than normal.

Diabetes is caused by insufficient insulin being produced.

(a) (i) Which organ monitors blood glucose concentration?

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(1)

(ii) Insulin reduces the concentration of glucose in the blood.

Describe how insulin does this.

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(1)

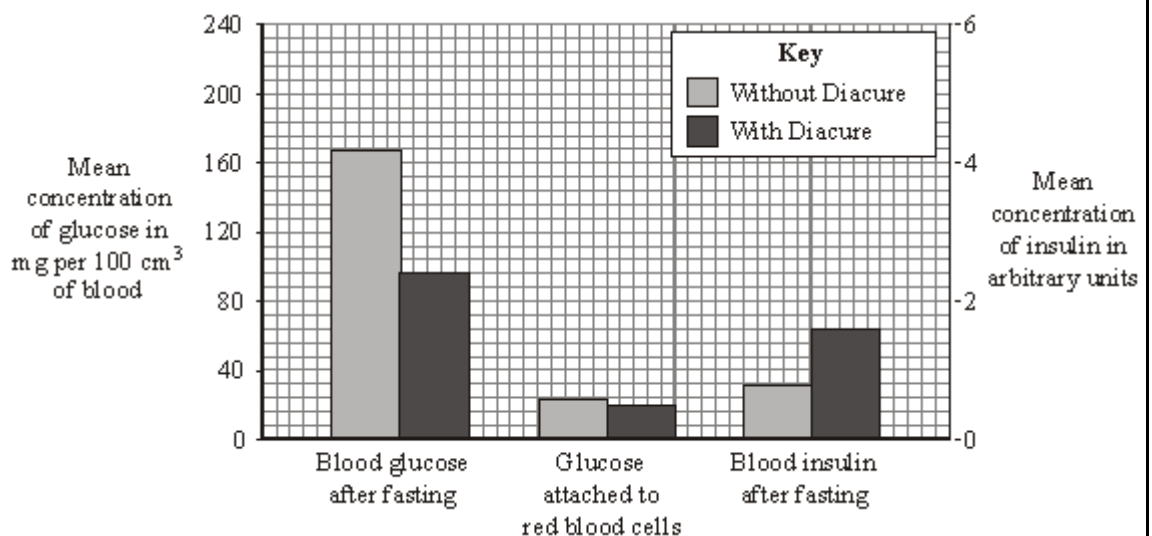
(b) A person with diabetes can be monitored in three ways:

- measuring the blood glucose concentration after fasting (going without food for 12 hours)
- measuring the amount of glucose attached to red blood cells: this is a measure of the average blood glucose concentration over the previous three months
- measuring the concentration of insulin in the blood after fasting

The manufacturer of a new treatment for diabetes, called Diacure, publishes the following two claims.

1. 98.6% of all people who used Diacure reported an improvement in their condition.

2. An independent study of 30 diabetic patients showed a significant reduction in blood glucose concentrations and a significant increase in insulin production, as shown by the graph.



(i) Which of the manufacturer's claims is **not** based on scientific evidence?

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(1)

(ii) Why might the data in this study be unreliable?

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(1)

(iii) The manufacturer did **not** draw attention to the data for the amount of glucose attached to red blood cells.

Suggest an explanation for this.

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(2)

(iv) The study of diabetic patients was carried out by an independent company.

Why is it important that the study should be independent?

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(1)

(Total 7 marks)

**Q3.**

Coordination of the body can be affected  
by chemicals called hormones

(a) (i) Where are hormones produced?

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(1)

(ii) How do hormones move around the body?

\_\_\_\_\_ (1)

(b) Insulin is a hormone.

(i) Where is insulin produced?

\_\_\_\_\_ (1)

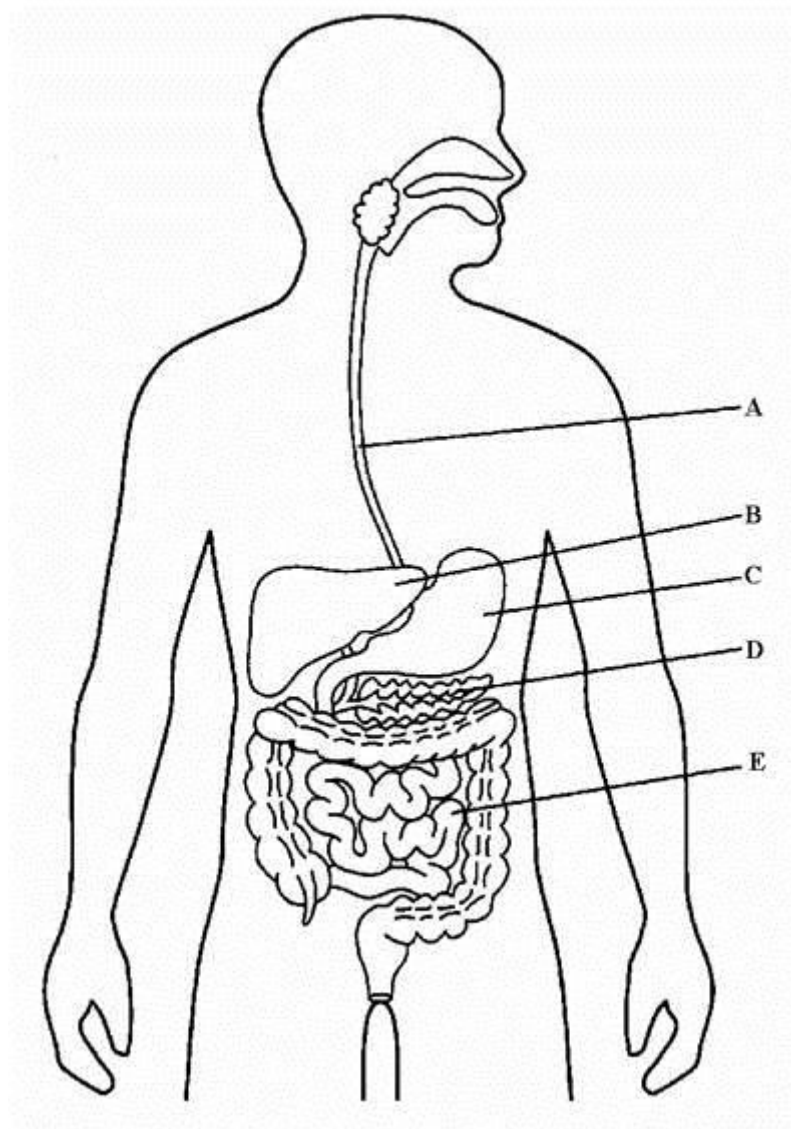
(ii) Explain the role of insulin in controlling blood sugar levels.

\_\_\_\_\_ (4)

(Total 7 marks)

**Q4.**

The diagram shows part of the human digestive system.



(i) Name part **B**.

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(1)

(ii) Describe the role of **B** and **D** in reducing blood sugar levels.

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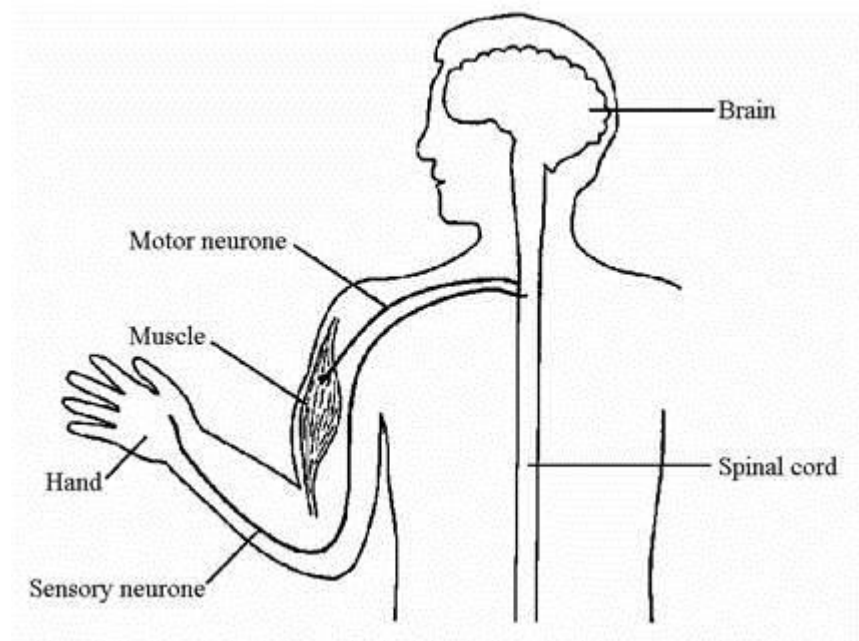
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(2)

(Total 3 marks)

**Q5.**

The diagram shows a reflex pathway in a human.



(a) Label the *receptor* on the diagram.

(1)

(b) Label the *effector* on the diagram.

(1)

(c) (i) Suggest a stimulus to the hand that could start a reflex response.

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(1)

(ii) Describe the response that this stimulus would cause. \_\_\_\_\_

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(1)

- (d) Put arrows on the diagram to show the direction of the path taken by the nerve impulses.

(1)

(Total 5 marks)

**Q6.**

- (a) During respiration, sugar is oxidised to release energy. Complete the equation for respiration.

Sugar + \_\_\_\_\_ = \_\_\_\_\_ + \_\_\_\_\_ + energy

(3)

- (b) The photograph below shows an athlete using an exercise machine. The machine can be adjusted to vary the rate at which the athlete is required to work.

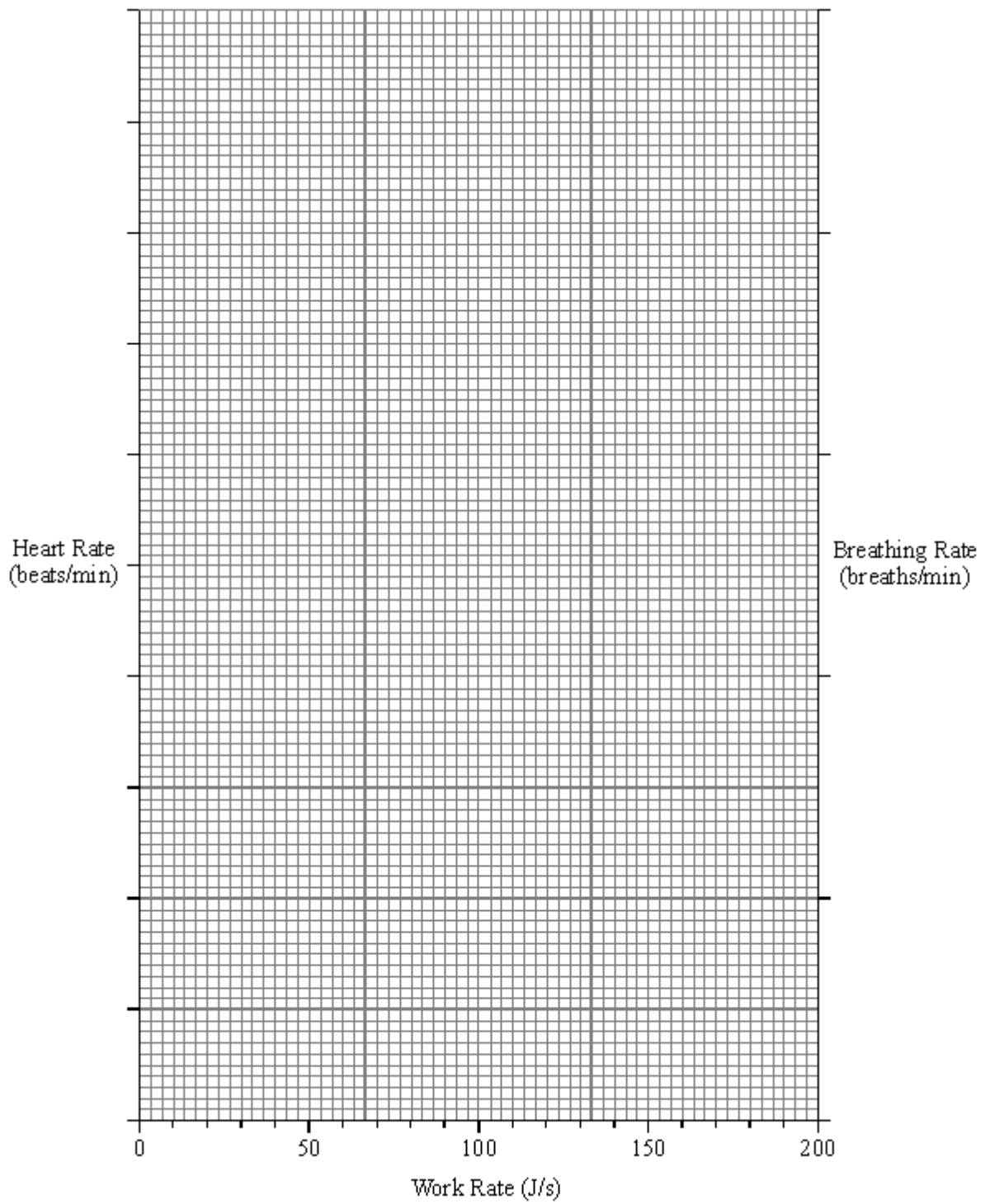


The athlete's heart rate and breathing rate were measured at different work rates.

The table below shows the results which were obtained.

WORK RATE (J/s)	HEART RATE (beats/min.)	BREATHING RATE (breaths/min.)
0	86	9.6
60	106	10.0
80	112	10.4
100	122	10.4
120	135	11.4
140	143	14.5
160	156	15.8
200	174	30.5

Plot the data on the graph paper below.



(3)

- (c) Explain, as fully as you can, the advantages to the body in the change in breathing and heart rates.

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- (a) How much more energy was lost from the body each second by sweating when the body temperature was 37.6 °C than when it was 36.6 °C? Show clearly how you work out your final answer.

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Amount of energy = \_\_\_\_\_ joules per second

(2)

- (b) Explain why a person would feel more thirsty when the body temperature was 37.6 °C than when it was 36.6 °C.

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(2)

- (c) Explain how sweating helps to control body temperature.

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(3)

(Total 7 marks)

### Q8.

Hormones are sometimes used to regulate human reproduction.

- (a) (i) What is a hormone?

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(1)

- (ii) How are hormones transported around the body?

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(1)

- (b) Describe the benefits and possible problems that may result from the use of hormones to regulate human reproduction. You should refer to fertility drugs and contraceptives in your answer.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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(4)

(Total 6 marks)

### Q9.

The pancreas is involved in digestion and controlling the internal conditions of the body.

- (a) Name **two** digestive enzymes produced by the pancreas.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

- (b) Diabetes may be caused by a lack of insulin.

Part of the treatment for someone with diabetes is to pay careful attention to the diet.

- (i) Give **one** symptom of diabetes.

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(1)

- (ii) Give **one** way in which a diabetic may be advised to change their diet.

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(1)

- (iii) How does this change in diet help the diabetic?

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(1)

(iv) State **one** other way in which the symptoms of diabetes may be treated.

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(1)

(c) Many of the cells in the pancreas contain large numbers of ribosomes.

What is the function of ribosomes in a cell?

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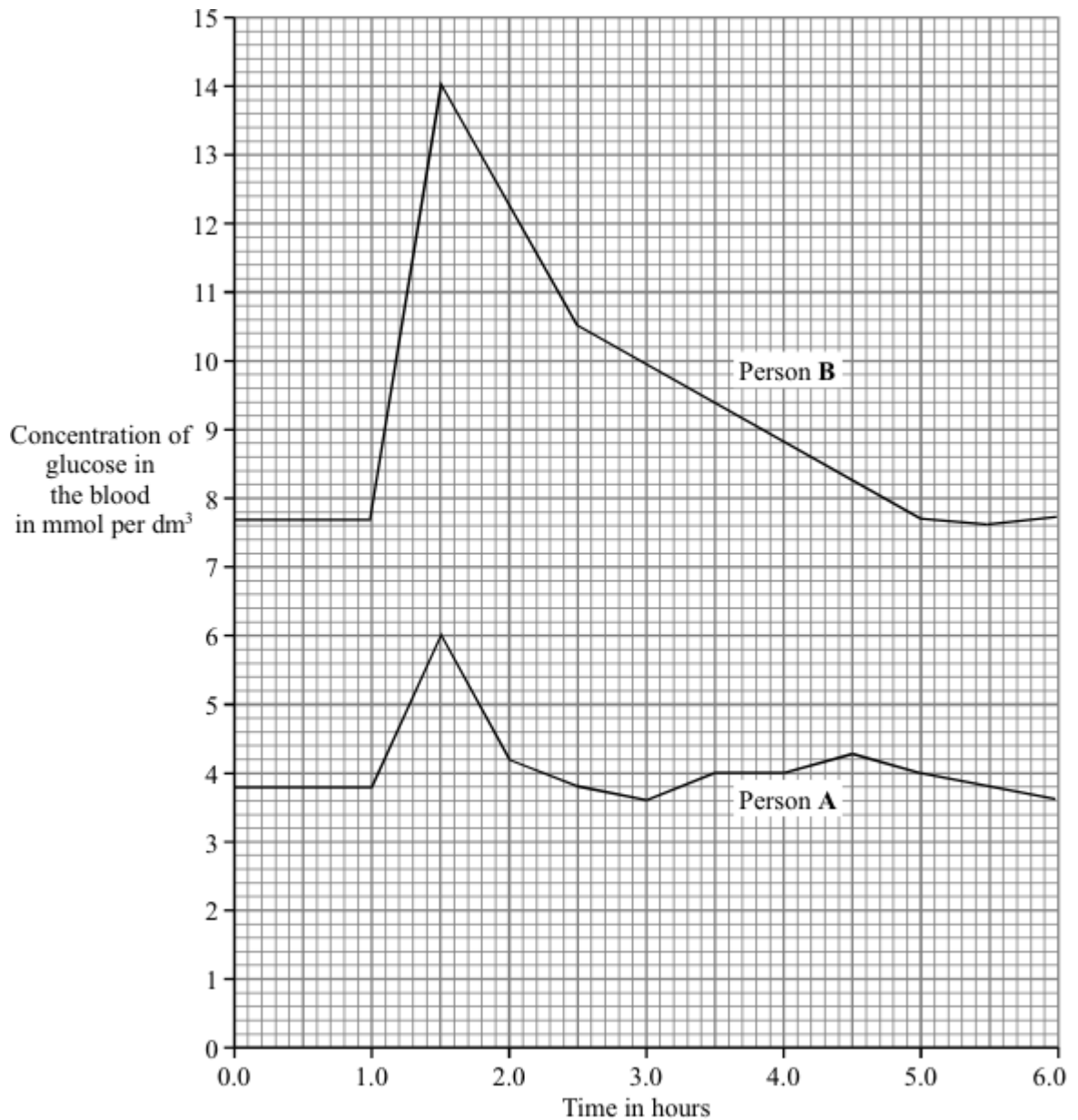
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(1)

(Total 7 marks)

**Q10.**

The graph shows the concentration of glucose in the blood of two people. Person **A** is a non-diabetic. Person **B** has diabetes. Each person ate 75 grams of glucose at 1.0 hours.



- (a) (i) What was the maximum concentration of glucose in the blood of Person **A**?  
 \_\_\_\_\_ mmol per dm<sup>3</sup> (1)
- (ii) After eating the glucose, how long did it take for the concentration of glucose in the blood of Person **B** to return to normal?  
 \_\_\_\_\_ hours (1)
- (b) A diabetic person does not produce enough insulin.
- (i) Which organ produces insulin?  
 \_\_\_\_\_ (1)
- (ii) Write the letter **X** on the graph to show one time when the blood of Person **A** would contain large amounts of insulin. (1)

- (c) A high concentration of glucose in the blood can harm body cells as a result of osmosis.  
Explain why.

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(4)  
(Total 8 marks)

**Q11.**

Reflex actions are rapid and automatic.

- (a) Name the following structures in a reflex action.

- (i) The structure that detects the stimulus.

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(1)

- (ii) The neurone that carries impulses to the central nervous system.

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(1)

- (iii) The neurone that carries impulses away from the central nervous system.

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(1)

- (iv) The structure that brings about the response.

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(1)

- (b) Describe what happens at a synapse when an impulse arrives.

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(2)

- (c) Some people have a condition in which information from the skin does not reach the brain.

Explain why this is dangerous for the person.

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(2)

(Total 8 marks)

**Q12.**

In diabetics blood glucose concentrations are sometimes abnormal.

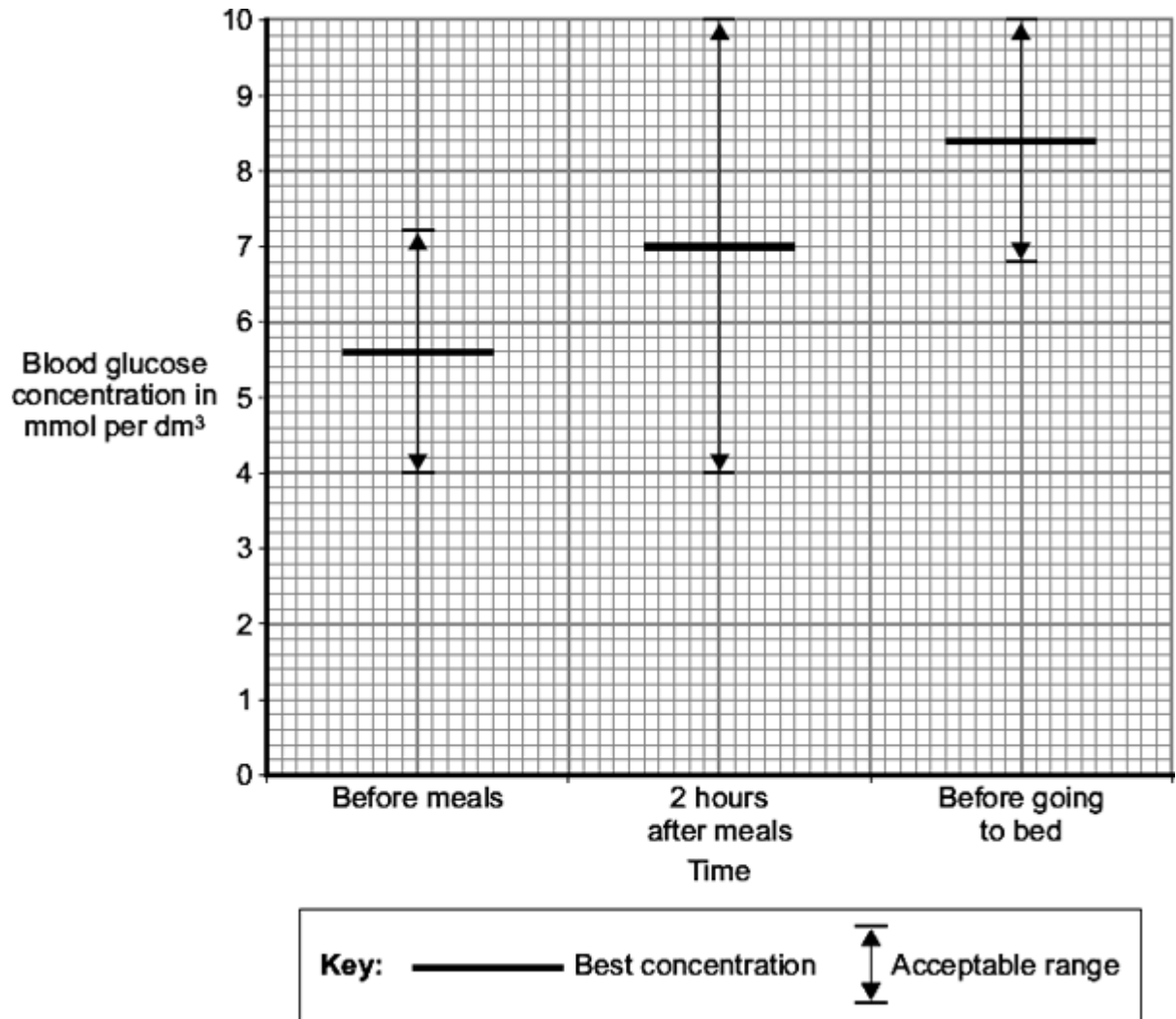
- (a) Name the organ that monitors the concentration of glucose in the blood.

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(1)

- (b) Diabetics can measure their blood glucose concentration.

The graph shows the best blood glucose concentration and the acceptable range of blood glucose concentration at different times.



What is the acceptable range for the blood glucose concentration before meals?

From \_\_\_\_\_ to \_\_\_\_\_ mmol per dm<sup>3</sup>

(1)

- (c) The amount of insulin a diabetic injects can be changed so that blood glucose concentration is kept near to the best level.

Two hours after eating breakfast a diabetic measures his blood glucose concentration.

His blood glucose concentration is 13 mmol per dm<sup>3</sup>.

He reads these instructions:

- for every 2 mmol per dm<sup>3</sup> of blood glucose *above* the best concentration, inject 1 unit *more* of insulin
- for every 2 mmol per dm<sup>3</sup> of blood glucose *below* the best concentration, inject 1 unit *less* of insulin.

How should he change his normal insulin injection to bring his blood glucose level to the best concentration?

Show clearly how you work out your answer.

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Answer = \_\_\_\_\_

(3)  
(Total 5 marks)

**Q13.**

The human body produces many hormones.

(a) (i) What is a *hormone*?

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(1)

(ii) Name an organ that produces a hormone.

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(1)

(iii) How are hormones transported to their target organs?

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(1)

(b) Describe how the hormones FSH, oestrogen and LH are involved in the control of the menstrual cycle.

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(3)  
(Total 6 marks)

**Q14.**

It is important that the concentration of glucose (sugar) in the blood is controlled.

- (a) (i) Which hormone controls the concentration of glucose in the blood?

\_\_\_\_\_

(1)

- (ii) Which organ produces this hormone?

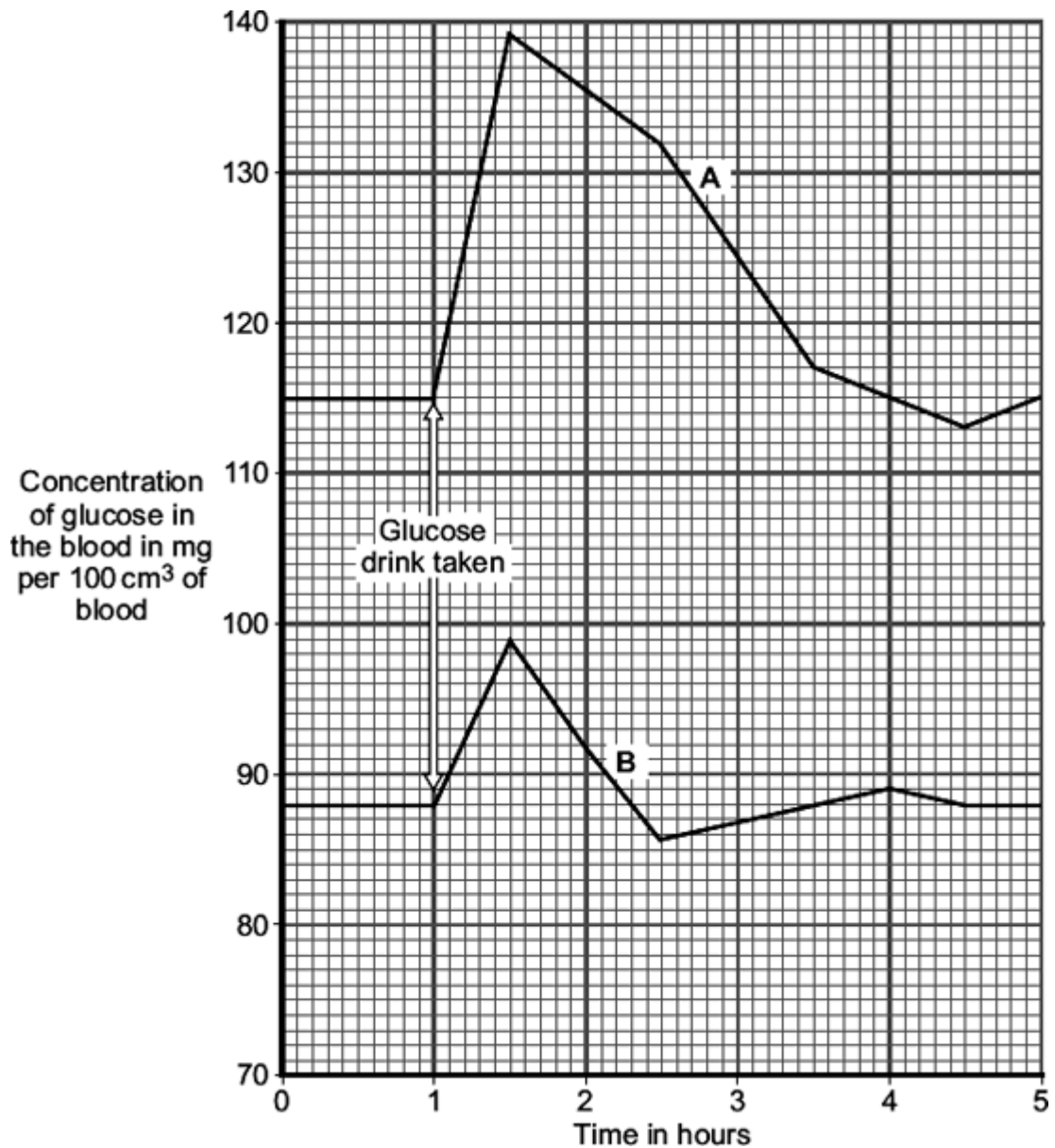
\_\_\_\_\_

(1)

- (b) The concentration of glucose in the blood of two people, **A** and **B**, was measured every half an hour.

One hour after the start, both people drank a solution containing 50 g of glucose.

The graph shows the result.



- (i) By how much did the blood glucose concentration in person **B** rise after drinking the glucose drink?

\_\_\_\_\_ mg per 100 cm<sup>3</sup> of blood

(1)

(ii) A doctor suggests that person **A** has diabetes.

Give **two** pieces of evidence from the graph to support this suggestion.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(iii) Give **one** reason for the fall in blood glucose concentration in person **B**, shown in the graph.

\_\_\_\_\_

(1)

(Total 6 marks)

### Q15.

Amylase is an enzyme that digests starch.

A student investigated the effect of pH on the activity of amylase.

This is the method used.

1. Mix amylase solution and starch suspension in a boiling tube.
2. Put the boiling tube into a water bath at 25 °C.
3. Remove a drop of the mixture every 30 seconds and test it for the presence of starch.
4. Repeat the investigation at different pH values.

The table below shows the students' results.

pH	Time when no starch was detected in minutes
5.0	7.0
5.5	4.5
6.0	3.0
6.5	2.0
7.0	1.5
7.5	1.5
8.0	2.0

(a) The student concluded pH 7.25 was the optimum pH for the amylase enzyme.

This is **not** a valid conclusion.

Suggest **two** reasons why.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

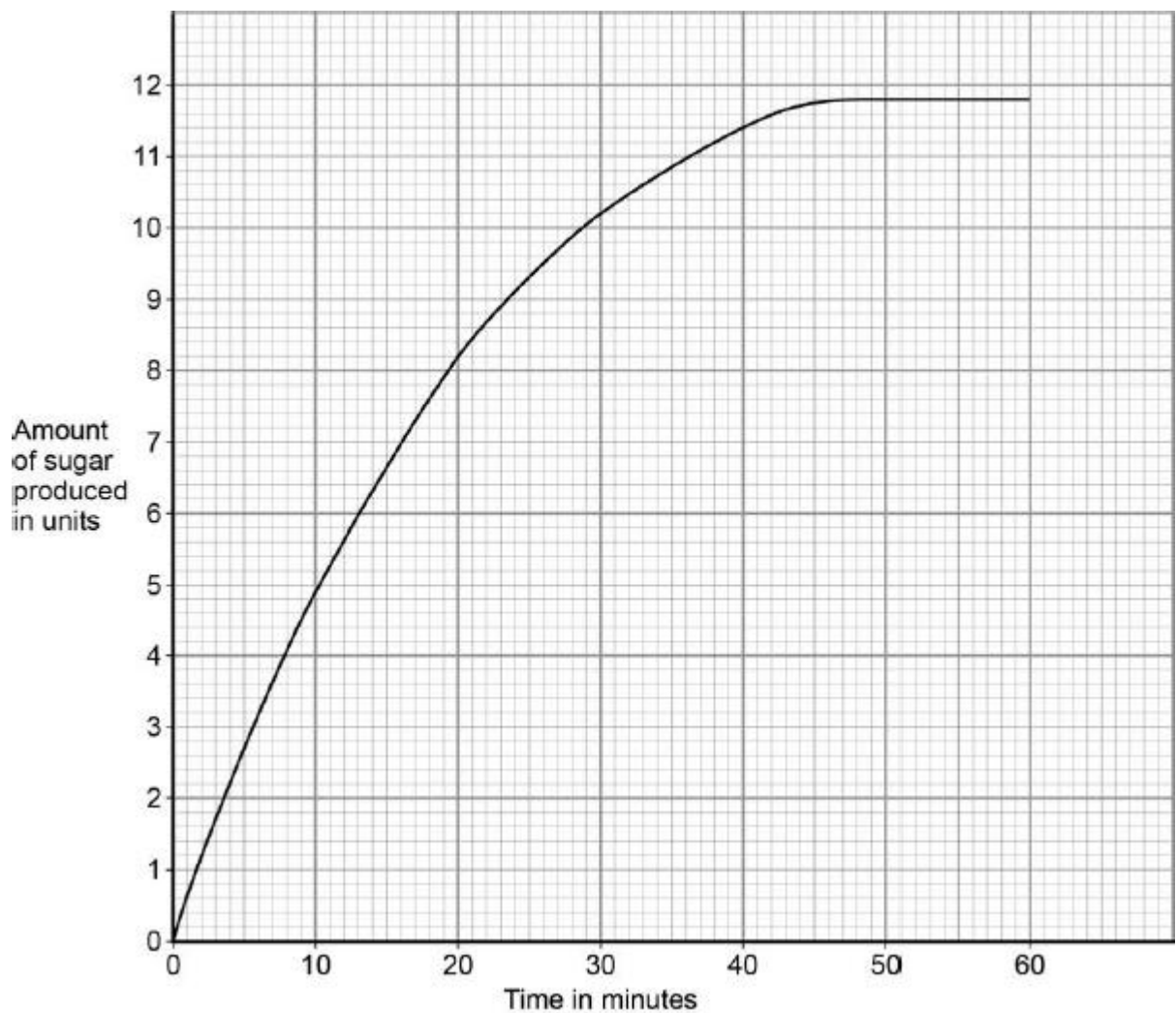
(2)

(b) The student did another investigation.

This is the method used.

1. Put amylase solution and starch suspension into a boiling tube.
2. Make the pH 7.25.
3. Put the boiling tube into a water bath at 25 °C.
4. Measure the amount of sugar produced every 30 seconds.

The results are shown in the figure below.



Calculate the mean rate of sugar produced per minute during the first 5 minutes.

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Mean rate = \_\_\_\_\_ units per minute

(2)

- (c) Iodine solution is added to a sample taken from the boiling tube after 10 minutes and 60 minutes.

Suggest what you would see in these samples.

After 10 minutes \_\_\_\_\_

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After 60 minutes \_\_\_\_\_

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(2)

- (d) The scientist repeated the investigation at 37 °C.

Draw a line on the figure above to show the results the scientist would get.

(2)

- (e) The same investigation was done at 65 °C.

How would this affect the results?

Explain why.

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(3)

(Total 11 marks)

**Q16.**

Diabetes is a disease in which a person's blood glucose concentration may rise.

Doctors give people drugs to treat diabetes.

The table shows some of the side effects on the body of four drugs, **A**, **B**, **C** and **insulin**, used to treat diabetes.

Drug	Side effects on the body
<b>A</b>	Weight loss Liver, kidney and heart damage Feeling of sickness
<b>B</b>	Weight gain Damage to some cells in pancreas
<b>C</b>	More water is kept in the body Weight gain Increased chance of bone breakage in women
<b>Insulin</b>	A little more water is kept in the body Weight gain Increased risk of lung damage

- (a) Which drug, **A**, **B**, **C** or **insulin**, is most likely to result in an increase in blood sugar concentration in some people?

Explain your answer.

Drug \_\_\_\_\_

Explanation

\_\_\_\_\_  
\_\_\_\_\_

(2)

- (b) (i) Drugs **A**, **B** and **C** can be taken as tablets.

The chemicals in the tablets are absorbed into the blood from the digestive system.

Insulin is a protein.

Insulin **cannot** be taken as a tablet.

Why?

\_\_\_\_\_

(1)

- (ii) Other than using drugs, give **two** methods of treating diabetes.

1. \_\_\_\_\_

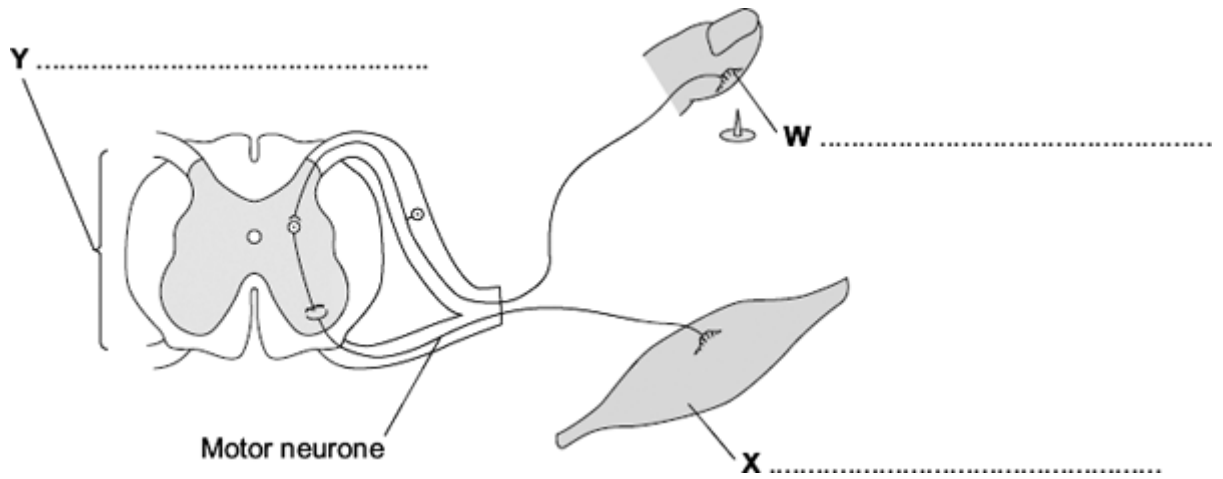
2. \_\_\_\_\_

(2)

(Total 5 marks)

### Q17.

The diagram shows the structures involved in a reflex action.



(a) On the diagram, name the structures labelled **W**, **X** and **Y**. (3)

(b) The control of blood sugar level is an example of an action controlled by hormones.

Give **two** ways in which a reflex action is different from an action controlled by hormones.

1. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 5 marks)

**Q18.**

(a) **List A** gives the names of three stages in trialling a new drug.

**List B** gives information about the three stages.

Draw a line from each stage in **List A** to the correct information in **List B**.

**List A**  
Stage

**List B**  
Information

Tests on humans  
including a placebo

Used to find if the drug is toxic

The first stage in the clinical trials

Tests on humans using very small quantities of the drug

of the drug

Tests on animals

Used to find the optimum dose of the drug

Used to prove that the drug is effective on humans

(3)

(b) Read the passage.

**Daily coffee dose delays development of Alzheimer's in humans.**

Alzheimer's is a brain disease that causes memory loss in elderly people. Scientists studied 56 mice that had been genetically engineered to develop Alzheimer's.

Before treatment all the mice did badly in memory tests.

Half the mice were given a daily dose of caffeine in their drinking water. The dose was equivalent to the amount of caffeine in six cups of coffee for a human.

The other mice were given ordinary water.

After two months, the caffeine-drinking mice did better in memory tests than the mice drinking ordinary water.

The headline for the passage is not justified.

Explain why as fully as possible.

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**Q19.**

- (a) Control systems help to keep conditions in the human body relatively constant.

What is the general name for the processes that keep body conditions relatively constant?

Draw a ring around the correct answer.

**eutrophication          homeostasis          hydrotropism**

(1)

- (b) The concentration of glucose in the blood is controlled by hormones.

Use the correct answer from the box to complete each sentence.

<b>glucagon</b>	<b>glycerol</b>	<b>glycogen</b>
<b>kidney</b>	<b>liver</b>	<b>pancreas</b>

When the blood glucose concentration increases, an organ called the \_\_\_\_\_ releases the hormone insulin.

Insulin causes glucose to move from the blood into the cells of the muscles and the \_\_\_\_\_ .

Inside these organs, the glucose is changed into a carbohydrate called \_\_\_\_\_ , which can be stored.

When the blood glucose concentration falls, another hormone is released, which causes the storage carbohydrate to break down into glucose again.

This hormone is called \_\_\_\_\_ .

(4)

- (c) A person with Type 1 diabetes does not make enough insulin.

The person needs to test their blood at intervals throughout the day.

If the concentration of glucose in their blood is too high, the diabetic person needs to inject insulin.

- (i) Insulin is a protein.

It must be injected and cannot be taken by mouth.

Explain why.

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(2)

- (ii) Apart from injecting insulin, give **one other** way that a diabetic person could help to control the concentration of glucose in their blood.

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(1)

- (d) Pet dogs have been trained to detect if the concentration of glucose in the blood of their diabetic owners is outside the normal healthy range. These dogs are called 'medical response dogs'.  
The dogs respond in different ways. They may bark, jump up, or stare at their owners. They may even fetch a blood-testing kit.

- (i) Suggest what stimulus the dogs might be responding to when they behave like this.

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(1)

- (ii) **Table 1** shows how the concentration of glucose varied in blood samples from five diabetic people. Measurements were made both before and after getting a medical response dog.

**Table 1**

		Mean percentage of blood samples with different concentrations of glucose from the five diabetic people			
		Number of blood samples measured	Low glucose	Within normal range of glucose	High glucose
Before getting a dog	1704	32.6	54.8	12.6	
After getting a dog	1724	18.6	61.6	19.8	

A survey was made of the effect of a medical response dog on the lives of 16 diabetic people.

**Table 2** shows how well these diabetic people agreed with each statement in the survey.

**Table 2**

Statement in	Totally	Somewhat	Neither	Somewhat	Totally
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survey	agree	agree	agree nor disagree	disagree	disagree
I am more independent since getting my dog.	12	2	2	0	0
There are disadvantages to having a medical response dog.	0	0	4	4	8
I trust my dog to alert me when my sugar levels are low.	11	3	1	0	1
I trust my dog to alert me when my sugar levels are high.	6	7	0	1	2

Evaluate how useful medical response dogs are for warning diabetic people that the concentration of glucose in their blood is outside the normal range.

Use information from **Tables 1** and **2**.

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(5)

- (e) **Table 3** shows the concentrations of some substances in the urine of a non-diabetic person and in the urine of a diabetic person.

**Table 3**

Substance	Concentration of substance in urine in g per dm <sup>3</sup>	
	Non-diabetic person	Diabetic person
Protein	0	0

Glucose	0	2.0
Urea	20.0	19.5
Sodium ions	6.0	5.8

Compare the results for the non-diabetic person and the diabetic person.  
Give reasons for any differences.

Use your knowledge of how the kidney works.

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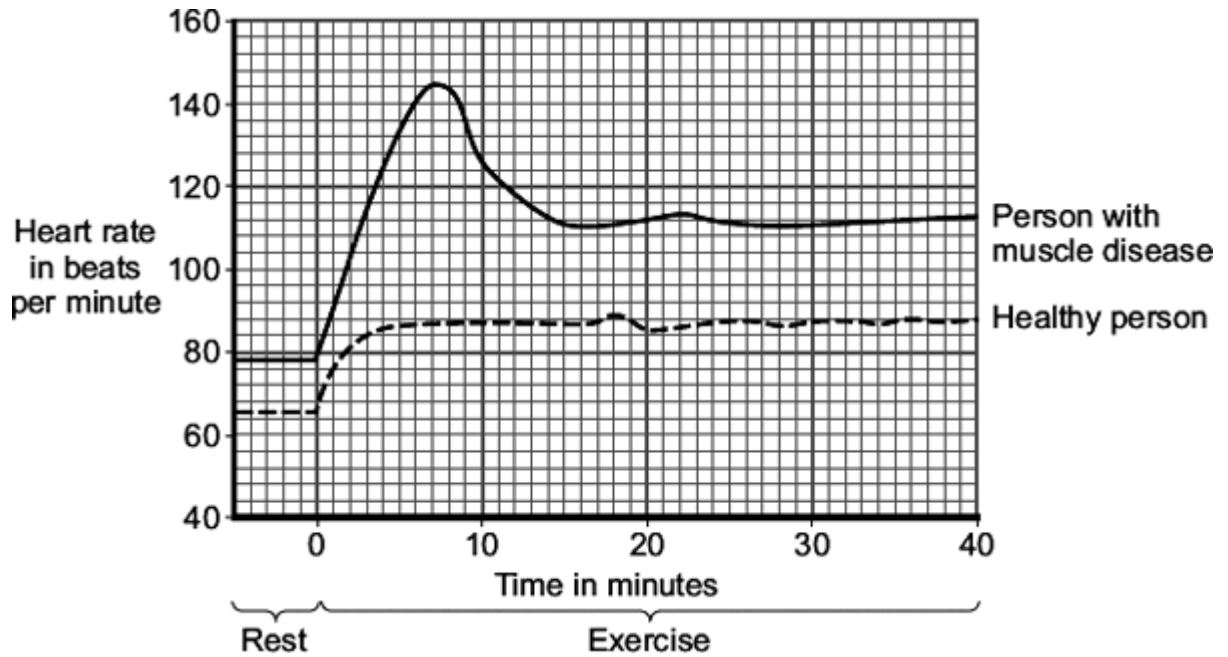
(5)

(Total 19 marks)

**Q20.**

Two people did the same amount of gentle exercise on an exercise cycle.  
One person had a muscle disease and the other had healthy muscles.

The graph shows the effect of the exercise on the heart rates of these two people.



- (a) Describe **three** ways in which the results for the person with the muscle disease are different from the results for the healthy person.

To gain full marks in this question you need to include data from the graph in your answer.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_

(3)

- (b) The blood transports glucose to the muscles at a faster rate during exercise than when a person is at rest.

- (i) Name **one** other substance that the blood transports to the muscles at a faster rate during exercise.

\_\_\_\_\_

(1)

- (ii) People with the muscle disease are not able to store glycogen in their muscles.

The results shown in the graph for the person with the muscle disease are different from the results for the healthy person.

Suggest an explanation for the difference in the results.

\_\_\_\_\_  
\_\_\_\_\_

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(3)  
(Total 7 marks)

**Q21.**

This question is about the nervous system.

- (a) Describe the function of receptors in the skin.

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(2)

- (b) A response is caused when information in the nervous system reaches an effector.

- (i) There are two different types of effector.

Complete the table to show:

- the two different types of effector
- the response each type of effector makes.

Type of effector	Response the effector makes
1 .....	..... .....
2 .....	..... .....

(4)

- (ii) Some effectors help to control body temperature.

Give **one** reason why it is important to control body temperature.

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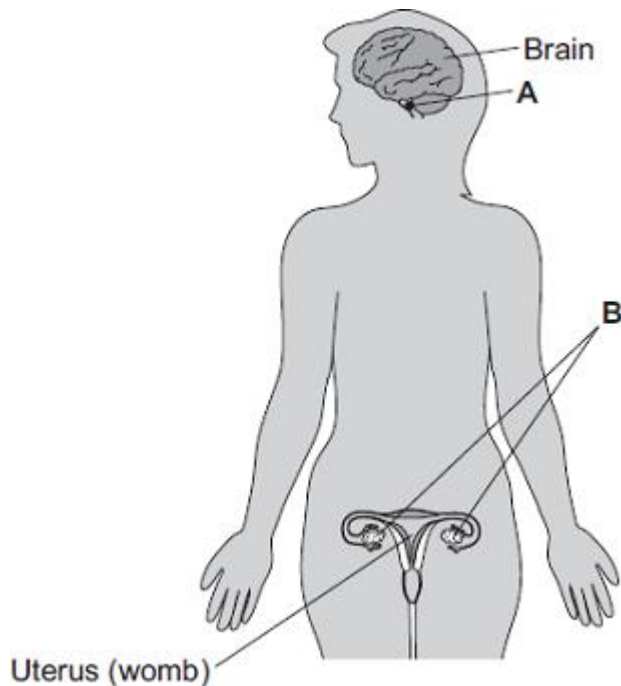
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(1)

(Total 7 marks)

**Q22.**

The diagram shows the position of two glands, **A** and **B**, in a woman.



- (a) (i) Name glands **A** and **B**.

**A** \_\_\_\_\_

**B** \_\_\_\_\_

(2)

- (ii) Gland **A** produces the hormone Follicle Stimulating Hormone (FSH).

FSH controls changes in gland **B**.

How does FSH move from gland **A** to gland **B**?

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(1)

- (b) (i) A woman is not able to become pregnant. The woman does not produce mature eggs. The woman decides to have In Vitro Fertilisation (IVF) treatment.

Which **two** hormones will help the woman produce and release mature eggs?

Tick (✓) **one** box.

FSH and Luteinising Hormone (LH)

FSH and oestrogen

Luteinising Hormone (LH) and oestrogen

(1)

- (ii) Giving these hormones to the woman helps her to produce several mature eggs.

Doctors collect the mature eggs from the woman in an operation.

Describe how the mature eggs are used in IVF treatment so that the woman may become pregnant.

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(3)

- (iii) IVF clinics have been set a target to reduce multiple births.

At least 76% of IVF treatments should result in single babies and a maximum of 24% of treatments should result in multiple births.

Suggest **one** reason why the clinics have been set this target to reduce multiple births.

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(1)

- (c) Two clinics, **R** and **S**, used IVF treatment on women in 2007. Doctors at each clinic used the results of the treatments to predict the success rate of treatments in 2008.

The table shows the information.

	Total number of IVF treatments in 2007	Number of IVF treatments resulting in pregnancy in 2007	Predicted percentage success rate in 2008
Clinic R	1004	200	18–23



Clinic <b>S</b>	98	20	3–56
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- (i) Compare the success rates of the two clinics in 2007.

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(1)

- (ii) The range of the predicted success rate in 2008 for clinic **R** is much smaller than the range of the predicted success rate for clinic **S**.

Suggest why.

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(2)

(Total 11 marks)

**Q23.**

One factor that may affect body mass is *metabolic rate*.

- (a) (i) What is meant by *metabolic rate* ?

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(1)

- (ii) Metabolic rate is affected by the amount of activity a person does.

Give **two** other factors that may affect a person's metabolic rate.

1. \_\_\_\_\_

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2. \_\_\_\_\_

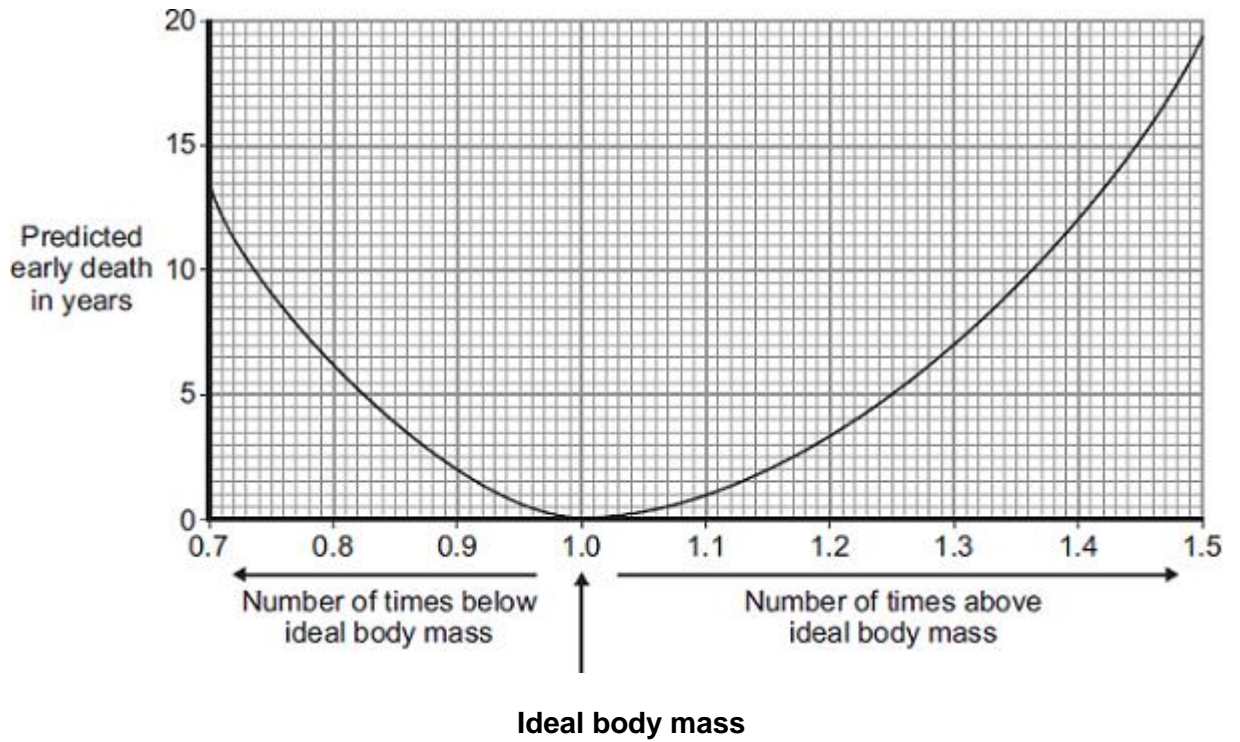
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(2)

- (b) Predicted early death is the number of years that a person will die before the mean age of death for the whole population. The predicted early death of a person is affected by their body mass.

Scientists have calculated the effect of body mass on predicted early death.

The graph shows the results of the scientists' calculations.



The number of times above or below ideal body mass is given by the equation:

$$\frac{\text{Actual body mass}}{\text{Ideal body mass}}$$

In the UK the mean age of death for women is 82.

A woman has a body mass of 70 kg. The woman's ideal body mass is 56 kg.

- (i) Use the information from the graph to predict the age of this woman when she dies.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Age at death = \_\_\_\_\_ years

(2)

- (ii) The woman could live longer by changing her lifestyle.

Give **two** changes she should make.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 7 marks)

Penguins live mainly in the Antarctic. Penguins eat mainly fish.  
**Photograph 1** shows a penguin swimming underwater.

**Photograph 1**



© raywooi/Stock

(a) Use information from **Photograph 1** to suggest **three** ways the penguin is adapted for catching fish.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

\_\_\_\_\_

(3)

(b) The Antarctic winter is very cold. In the winter some species of penguin huddle together as shown in **Photograph 2**.

**Photograph 2**



© Fuse

Suggest how the behaviour shown in **Photograph 2** helps the penguins to survive the Antarctic winter.

\_\_\_\_\_

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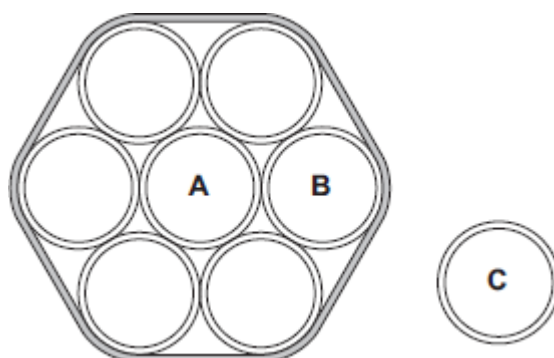
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(3)

- (c) A student did an investigation to model the behaviour of the penguins shown in **Photograph 2**.

The diagram shows the apparatus the student used.



The student:

- held seven similar test tubes together with elastic bands as shown in the diagram
- stood a similar eighth tube in a test tube rack
- filled each of the eight tubes with hot water to the same level
- measured the temperature of the water in tubes **A**, **B** and **C** every 2 minutes for 20 minutes.

The table shows the student's results.

Time in Minutes	Temperature in °C		
	Tube A	Tube B	Tube C
0	65	65	65
2	65	65	64
4	65	64	63
6	64	64	62
8	64	63	61
10	64	63	60
12	63	62	59

14	63	62	58
16	63	61	57
18	62	61	56
20	62	60	55

(i) Give **two** variables that were controlled in the investigation.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(ii) Describe the patterns the data shows.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(iii) How far does the data from the model support the suggestion you made in part **(b)**?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(2)

(d) Describe how blood vessels help control human body temperature.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

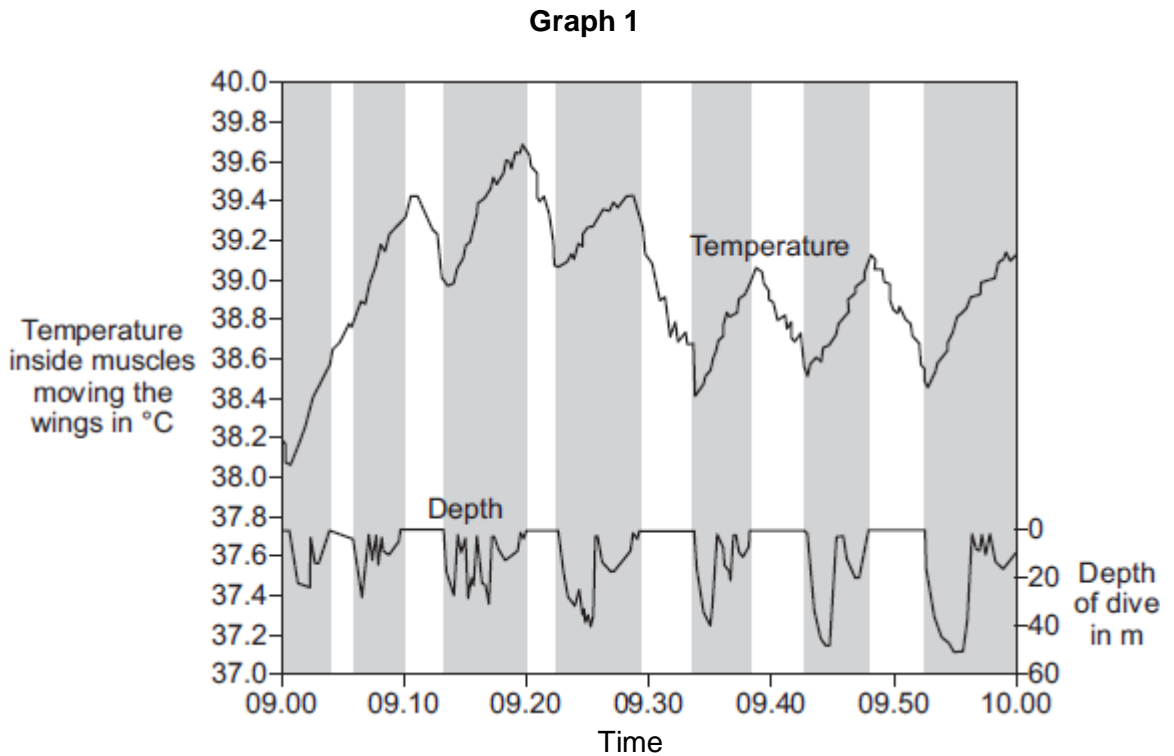
(4)

(e) Penguins control their body temperature in similar ways to humans. Scientists investigated changes in body temperature of penguins when the penguins

were diving to catch fish.

- (i) **Graph 1** shows the relationship between the temperature of the muscles moving a penguin's wings and diving.

The shaded areas show when the penguin was diving.



© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

Suggest an explanation for the changes in temperature inside the muscles moving the penguin's wings.

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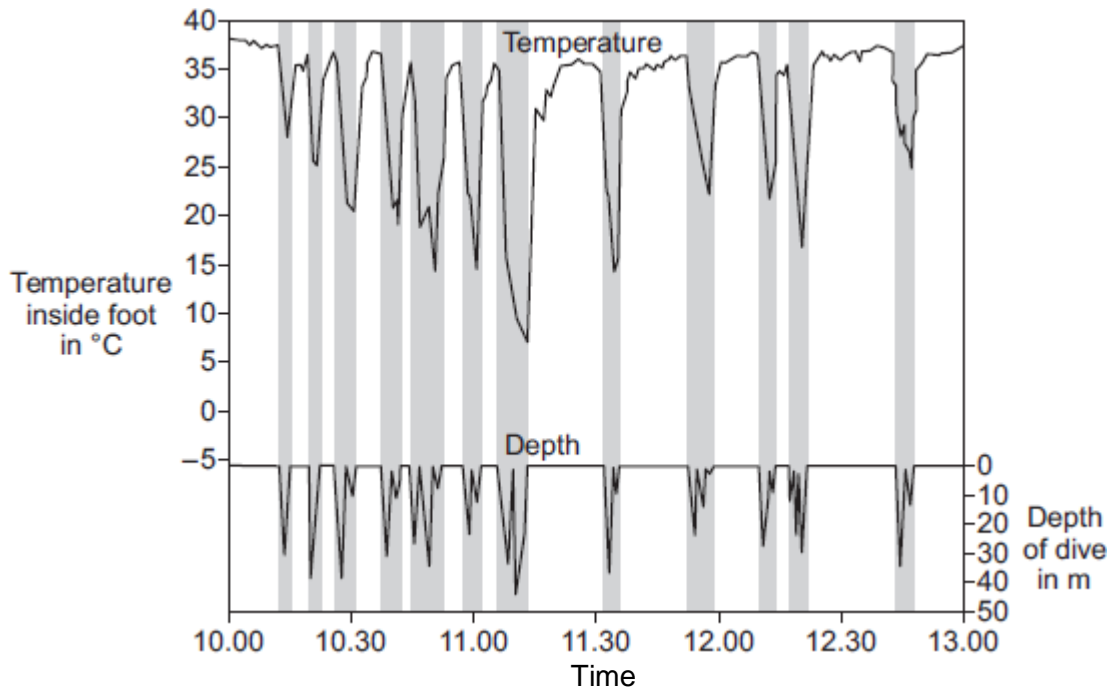
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(3)

- (ii) **Graph 2** shows the relationship between the temperature inside a penguin's foot and diving.

The shaded areas show when the penguin was diving.

**Graph 2**



© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

Suggest an explanation for the changes in temperature inside the penguin's foot as it dives.

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(3)  
(Total 22 marks)

**Q25.**

The rate of chemical reactions can be changed by changing the conditions.

- (a) Methane burns in oxygen to produce carbon dioxide and water.

The activation energy for the reaction is 2648 kJ / mol.

The reaction gives out 818 kJ / mol of energy.

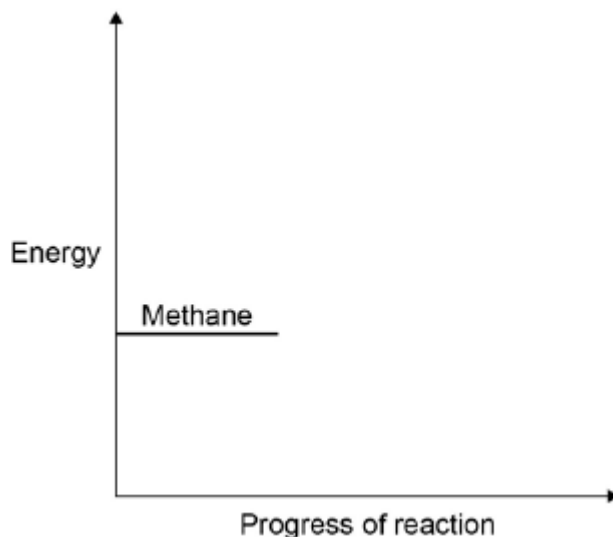
The figure below shows the reaction profile for this reaction.

Complete the reaction profile.

Draw arrows to represent:

- the activation energy

- the energy given out.



(4)

- (b) What percentage of the activation energy is the energy given out?

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(1)

- (c) Calcium carbonate decomposes when it is heated:

The decomposition of calcium carbonate is an endothermic reaction.

How would the reaction profile for decomposition of calcium carbonate be different from the reaction profile of methane burning in oxygen?

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(1)

- (d) Catalysts are used in chemical reactions in industry.

Give **two** properties of catalysts.

For each property, explain why it makes the catalyst useful in industry.

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(4)

- (e) Enzymes are biological catalysts.



What type of molecule is an enzyme?

Tick **one** box.

- |              |                          |
|--------------|--------------------------|
| Carbohydrate | <input type="checkbox"/> |
| Hydrocarbon  | <input type="checkbox"/> |
| Lipid        | <input type="checkbox"/> |
| Protein      | <input type="checkbox"/> |

(1)

(f) If enzymes are denatured they stop working.

Give **two** ways an enzyme can be denatured.

1. \_\_\_\_\_
2. \_\_\_\_\_

(2)

(g) An enzyme called lactase catalyses the reaction that breaks down lactose to smaller molecules.

One model used to explain how enzymes affect reactions is called the lock and key model.

Use the lock and key model to explain why lactase cannot be used to speed up **all** chemical reactions.

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(3)

(Total 16 marks)

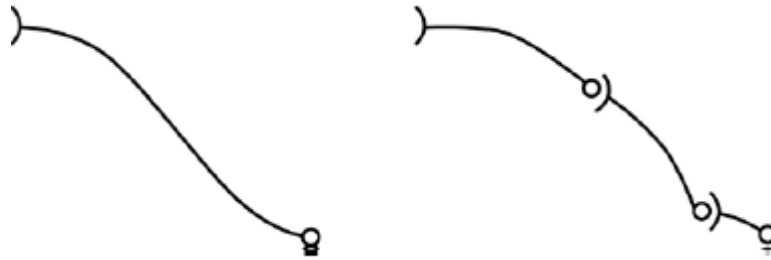
### Q26.

The nervous system allows humans to respond to their surroundings.

The figure below shows two nerve pathways.

**Nerve pathway A**

**Nerve pathway B**



(a) Nerve pathway **A** is 92 cm long.

A nerve impulse travels along pathway **A** at 76.2 m / s.

Calculate how long it takes for the nerve impulse to travel the length of the pathway.

Use the equation:

$$\text{distance} = \text{speed} \times \text{time}$$

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Time = \_\_\_\_\_ s

(3)

(b) Nerve pathways **A** and **B** are the same length.

The nerve impulse takes longer to travel along pathway **A** than along pathway **B**.

Use the figure above to explain why.

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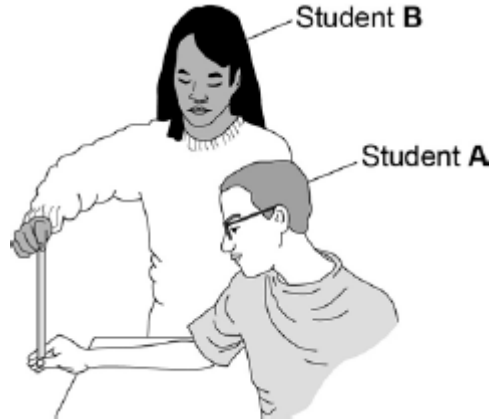
(3)

(c) Two students compare their reactions using a ruler.

This is the method used.

1. Student **A** sits with his elbow on a table top.
2. Student **B** holds the ruler so the bottom of the ruler is level with the top of student **A**'s thumb.
3. Student **B** drops the ruler.

4. Student **A** catches the ruler.
5. Record the drop distance.
6. Repeat steps 1 to 5 four more times.
7. Repeat the whole experiment with student **A** dropping the ruler and student **B** catching it.



Both students are right-handed.

Student **A** uses his right hand to catch the ruler.

Student **B** uses her left hand to catch the ruler.

The table below shows the students' results.

Student	Drop distance in mm				
	Test 1	Test 2	Test 3	Test 4	Test 5
Student <b>A</b> – right hand	203	167	140	156	163
Student <b>B</b> – left hand	230	211	279	215	264

What is the range of student **A**'s results?

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(1)

- (d) The students are testing the hypothesis:

**The drop distance of the ruler is smaller when a right-handed person uses their right hand to catch the ruler.**

The students' results in the table above are not a good test of the hypothesis.

Suggest what the students should have done to test the hypothesis.

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(3)

(e) Student **A**'s mean reaction time was 0.19 s.

Mean reaction time can be calculated using the equation:

$$\text{Mean reaction time} = \sqrt{\frac{2 \times \text{mean drop distance in m}}{9.8 \text{ m/s}^2}}$$

Calculate the mean reaction time for Student **B**.

Give your answer to two significant figures.

Student **B**'s results are repeated here to help you answer the question.

	Drop distance in mm				
	Test 1	Test 2	Test 3	Test 4	Test 5
Student <b>B</b> – left hand	230	211	279	215	264

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Mean reaction time = \_\_\_\_\_ s

(4)

(Total 14 marks)

**Q27.**

This question is about hormones.

(a) (i) Hormones carry messages.

What type of messenger is a hormone?

Draw a ring around the correct answer.

**chemical      electrical      environmental**

(1)

(ii) Which part of the brain secretes hormones?

Draw a ring around the correct answer.

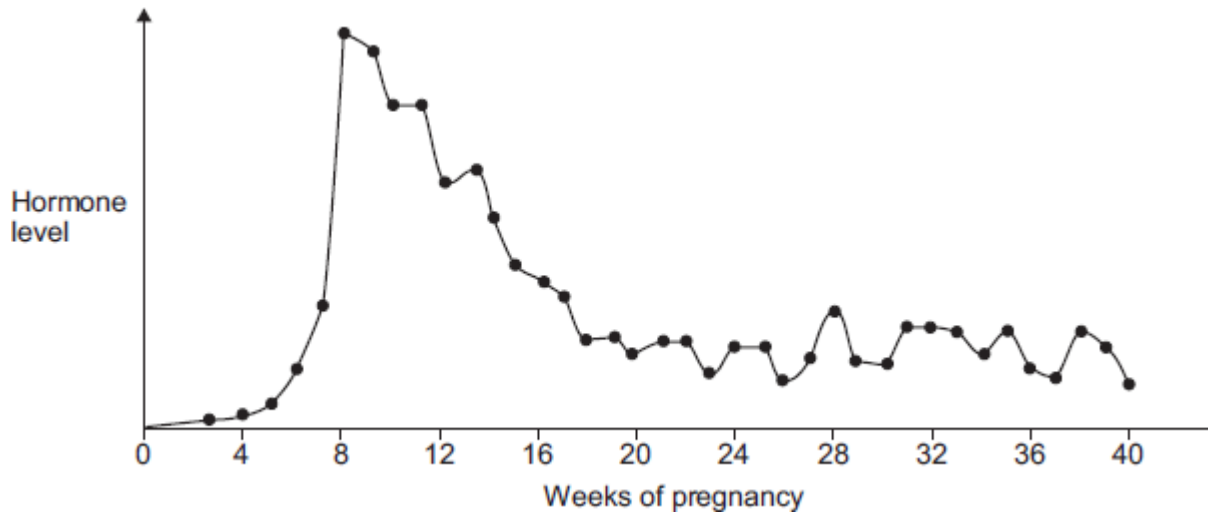
cerebellum    medulla    pituitary gland

(1)

(b) **Figure 1** shows the level of a pregnancy hormone over a 40-week pregnancy.

This hormone can be detected in a pregnancy test.

**Figure 1**



A woman takes a pregnancy test.

In which week of pregnancy is the test most likely to give a positive result?

Use information from **Figure 1**.

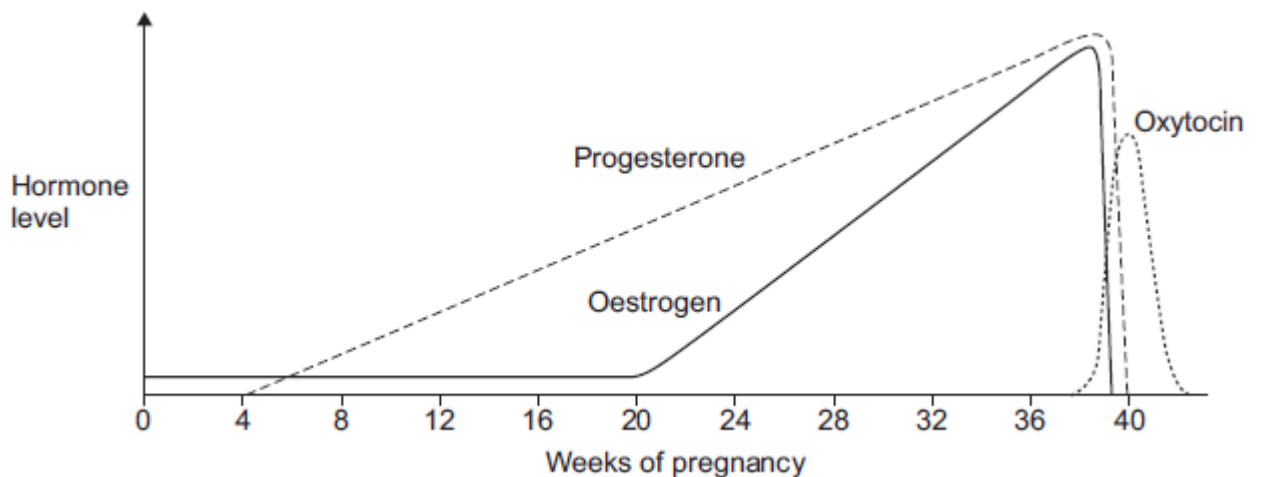
Write the correct answer in the box.

(1)

(c) **Figure 2** shows the levels of three other hormones during pregnancy.

The baby is usually born at about 40 weeks.

**Figure 2**



- (i) Describe the patterns in the levels of oestrogen and progesterone from 0 to 36 weeks.

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(4)

- (ii) Which hormone is likely to stimulate contractions of the uterus (womb) when the baby is born?

Use information from **Figure 2** to give a reason for your answer.

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(2)

(Total 9 marks)

**Q28.**

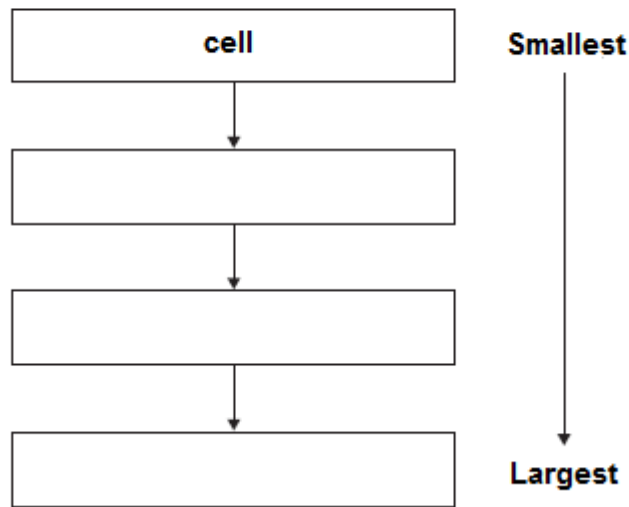
The human body is organised to carry out many different functions.

- (a) Use words from the box to complete **Figure 1** by putting the parts of the body in order of size from smallest to largest.

The smallest one has been done for you.



**Figure 1**



(2)

(b) The stomach is made of different types of tissue.

Draw **one** line from each type of stomach tissue to the correct description.

Epithelial tissue	Allows food to be churned around the stomach
Glandular tissue	Covers the outside and the inside of the stomach
Muscular tissue	Produces digestive juices
	Coordinates nerve impulses

(3)

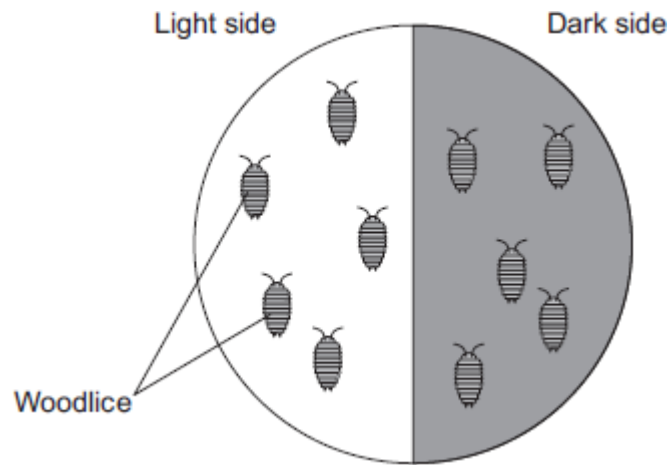
(c) Animals can react to their surroundings because they have nervous systems.

A student investigated the behaviour of small animals called woodlice.

The student set up the investigation as shown in **Figure 2**.

- The student covered one half of a Petri dish with black paper to make that side of the Petri dish dark.
- The other side had no cover.
- The student put five woodlice into each side of the dish and then put the clear Petri dish lid back on the dish.

**Figure 2**



After 30 minutes, all the woodlice had moved to the dark side of the Petri dish.

- (i) In this investigation, what is the **stimulus** that the woodlice responded to?

\_\_\_\_\_ (1)

- (ii) In this investigation, what is the **response** that the woodlice made?

\_\_\_\_\_ (1)

- (iii) The student concluded that woodlice prefer dark conditions.

Give **two** ways in which the student could improve the investigation to be sure that his conclusion was correct.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

(2)  
(Total 9 marks)

**Q29.**

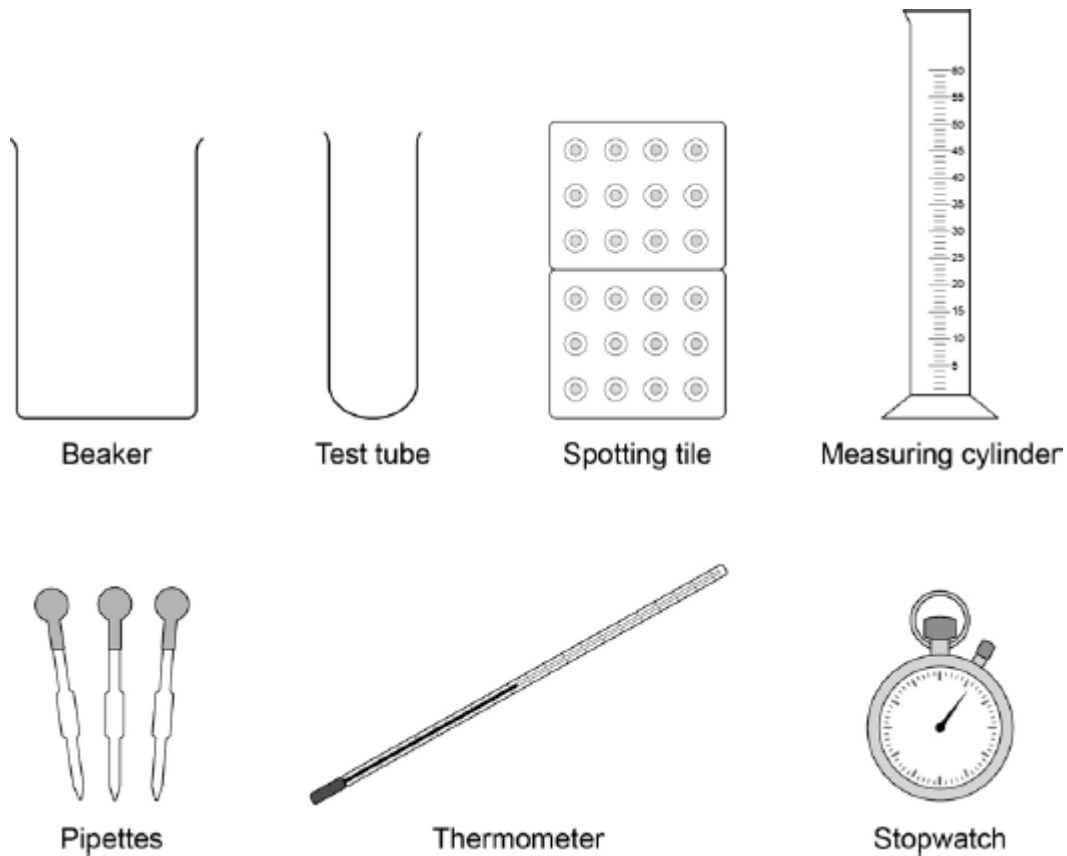
Amylase catalyses the breakdown of starch into sugars.

A student investigated the effect of amylase on the reaction at different temperatures.

**Figure 1** shows the apparatus the student used.

**Figure 1**





This is the method used.

1. Put starch suspension into a test tube.
2. Add amylase solution.
3. Put the test tube in a beaker of water at 15 °C.
4. Remove a small sample of the mixture every 30 seconds and put in a spotting tile.
5. Test the sample for starch.
6. Time how long it takes to break down all of the starch in the mixture.
7. Repeat steps 1–5 at 20 °C, 25 °C and 30 °C.
8. Repeat for each temperature twice more.

The table below shows the student's results.

Temperature in °C	Time taken until there was no starch in the sample in minutes			
	Test 1	Test 2	Test 3	Mean
15	6.1	9.4	10.0	8.5
20	4.8	5.0	4.6	4.8
25	3.0	2.5	3.0	3.2
30	1.5	2.0	2.0	

(a) One of the results in the table above is anomalous.

Draw a ring around the anomalous result.

(1)

(b) Calculate the mean for 30 °C.

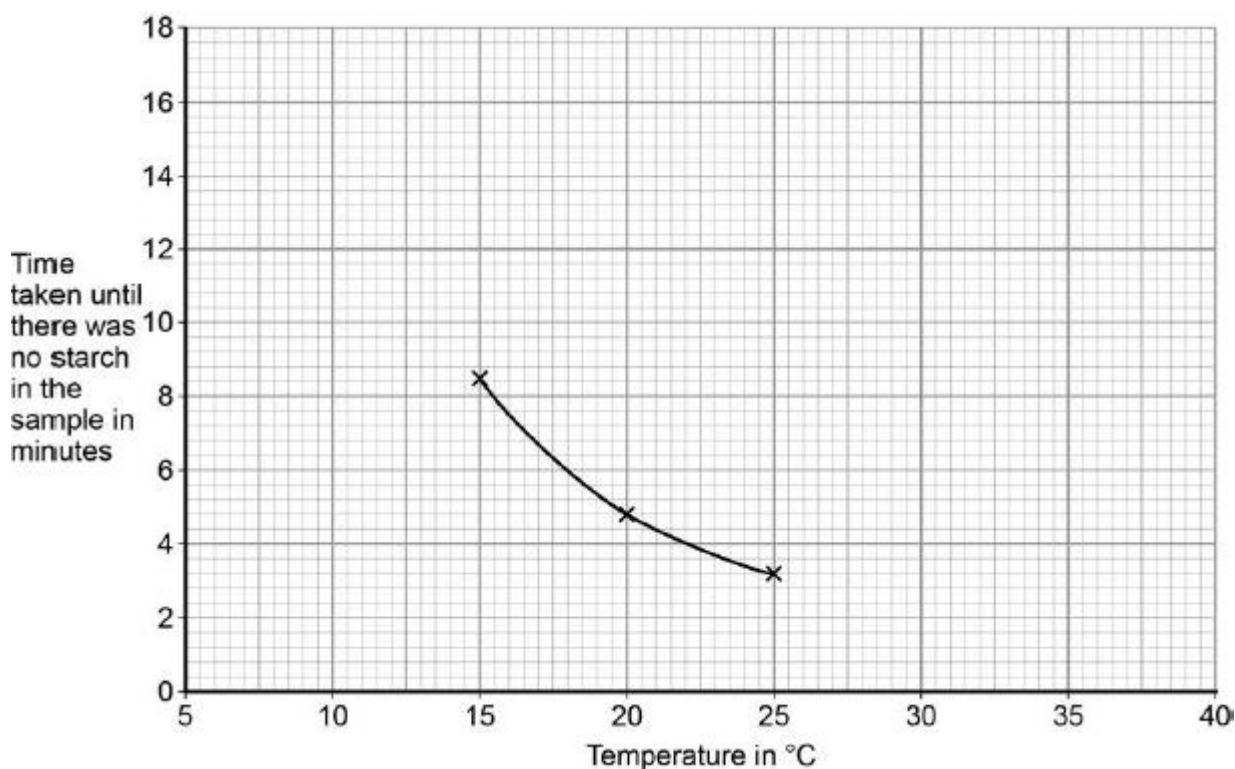
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(1)

(c) **Figure 2** shows a graph of the student's results.

**Figure 2**



Use the graph to predict how long it would take to break down all of the starch at 10 °C.

Time = \_\_\_\_\_ minutes

(1)

(d) The student tested samples of the mixture for starch every 30 seconds.

In each test she added one drop of iodine to the sample in the spotting tile.

Predict the colour of the samples from the 20 °C test at 4.0 minutes and 7.0 minutes.

Colour at 4.0 minutes \_\_\_\_\_

Colour at 7.0 minutes \_\_\_\_\_

(2)

(e) The student did a fourth test at 30 °C.

In this test the starch did not break down, even after 45 minutes.

Why did the amylase not break down the starch in this test?

Tick **one** box.

The amylase solution and the starch suspension were mixed before the start of the experiment.

The amylase solution had been prepared with water at 95 °C.

The amylase solution had been prepared with water at 20 °C.

The amylase solution had been stored in the fridge.

(1)

- (f) The student made the following conclusion about the optimum temperature for amylase to work at.

‘Amylase works fastest at 40 °C’

Her teacher said that this is **not** a valid conclusion from her results.

Describe how the student could change her method to give results that would improve the validity of her conclusion.

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(6)

(Total 12 marks)

**Q30.**

Neurones pass information around the body.

- (a) Why are reflex reactions important?

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(1)

(b) Caffeine is a drug found in coffee.

After a person drinks coffee information passes through neurones in the nervous system more quickly.

Suggest a hypothesis for the effect of caffeine concentration on reaction time.

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(1)

(c) Two students investigated the effect of caffeine concentration on reaction time.

This is the method used.

1. Student **A** drinks a cup of coffee.
2. Student **B** holds a ruler above Student **A**'s hand.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler as quickly as she can.
5. The distance the ruler falls is recorded.

Suggest how this method could be improved to produce valid results.

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(6)

(Total 8 marks)

**Q31.**

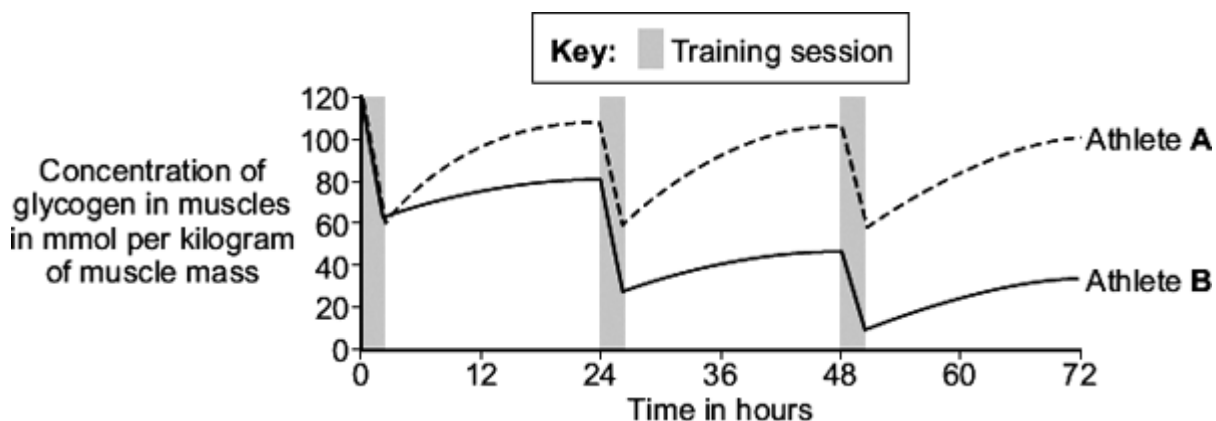
Glycogen is stored in the muscles.

Scientists investigated changes in the amount of glycogen stored in the muscles of two 20-year-old male athletes, **A** and **B**.

Athlete **A** ate a high-carbohydrate diet. Athlete **B** ate a low-carbohydrate diet.

Each athlete did one 2-hour training session each day.

The graph shows the results for the first 3 days.



(a) (i) Give **three** variables that the scientists controlled in this investigation.

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(3)

(ii) Suggest **two** variables that would be difficult to control in this investigation.

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(2)

(iii) Describe **one** way in which the results of Athlete **B** were different from the results of Athlete **A**.

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(1)

(b) Both athletes were training to run a marathon.

Which athlete, **A** or **B**, would be more likely to complete the marathon?

Use information from the graph to explain your answer.

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**(4)**  
**(Total 10 marks)**

## Mark schemes

### Q1.

(a) B

*no mark for ÉBÉ, alone*

large(r) surface / area **or** large(r) membrane

*accept reference to microvilli*

*accept reasonable descriptions of the surface*

*do **not** accept wall / cell wall*

*ignore villi / hairs / cilia*

1

(b) (i) any **one** from:

- insulin / hormone

*if named hormone / enzyme must be correct for pancreas*

- enzyme / named enzyme

1

(ii) many ribosomes

1

(ribosomes) produce protein

*accept insulin / hormone / enzyme named is (made of) protein*

**or**

allow many mitochondria (1)

provide energy to build protein **or** to make protein (1)

*accept ATP for energy*

1

[4]

### Q2.

(a) (i) pancreas

*allow phonetic spelling*

1

(ii) glucose into cells / liver / muscles

*allow any named organ / cell*

*allow turned into / stored as glycogen*

**but**

*do **not** allow hybrid spellings for glycogen*

*allow increases respiration*

*allow stored as / turned into fat*

1

(b) (i) reference to "98.6% of all people who used Diacure reported an improvement in their condition".

*allow claim 1 / 1 / the first one*

- 1
- (ii) (only) 30 patients **or** not enough / not many patients  
*allow only one trial or only done once or not repeated*  
*ignore bias*
  - 1
- (iii) little effect / difference  
*allow no effect*  
*allow only drops by 4 ( $\pm 1$ )*
  - 1
- suggest drug is not effective (in long term)  
*allow wouldn't persuade people to take it*
  - 1
- (iv) avoid bias / owtte  
  
eg company could change / ignore results / might lie  
*ignore fair / accurate / reliable / valid*
  - 1

[7]

**Q3.**

- (a) (i) endocrine glands **or** endocrine system  
*allow a specific named gland*
  - 1
- (ii) (dissolved) in the blood(stream) **or** plasma
  - 1
- (b) (i) pancreas **or** islets of Langerhans
  - 1
- (ii) (it **or** insulin) lowers blood sugar level [1]  
  
(by) (speeding up **or** increasing)  
conversion of glucose to glycogen [1]  
  
in the liver [1]  
  
(and) speeding up **or** increasing uptake of glucose by body cells [1]
  - 4

[7]

**Q4.**

- (i) liver
  - 1
- (ii) liver **or** B stores glycogen  
**or** pancreas **or** D makes insulin
  - 1
- clear description of link
  - 1

[3]



**Q5.**

- (a) label drawn to the hand  
*may be labelled as 'a'*  
*accept the receptor identified as the hand* 1
- (b) label drawn to the muscle  
*may be labelled as 'b'*  
*accept the effector identified as the muscle* 1
- (c) (i) sharp point **or** heat  
*accept specific examples such as pain, bee sting, cut, burning*  
*do **not** accept touch by itself* 1
- (ii) move the hand (or arm) away from stimulus  
**or**  
muscle in the arm contracts  
*do **not** credit reference to impulse reaching brain unless it is clear that this is in addition to the reflex act*  
*do **not** credit 'reflex action' already given* 1
- (d) an arrow on the sensory fibre from hand to spine  
*award **one** mark for both arrows in the correct direction*
- and**
- note the arrows may be drawn separately from the printed neurone*
- an arrow on the motor fibre from spine to muscle
- do **not** credit if the impulse travels to the muscle via the brain **but** a 'one way' journey to the brain will be neutral*
- 1

[5]

**Q6.**

- (a) oxygen;                    )  
carbon dioxide;        ) *allow symbols*  
water                        )  
*each for 1 mark* 3
- (b) graph with reasonable vertical scales;  
accurate plotting of all points (ignore lines) and labelling lines  
histogram – must be coded  
*gains 3 marks* 3
- (c) 6 of:

during exercise the level of CO<sub>2</sub> (in the blood) rises;  
increased breathing to remove excess CO<sub>2</sub>;  
increased oxygen supply to muscles;  
**or** increased breathing takes in more O<sub>2</sub>  
**or** increased heart rate takes more O<sub>2</sub> to muscles;  
increased supply of sugar to muscles;  
increased respiration rate;  
enable faster rate of energy release;  
reference to lactic acid (allow even though not on syllabus)/O<sub>2</sub> debt;  
to avoid cramp;  
anaerobic reference;  
reference to removal of 'heat';

6

- (d) high carbon dioxide concentration;  
brain/central nervous system;  
heart muscles (both)

3

[15]

### Q7.

- (a) 345 to 350

*ignore working or lack of working  
use of 355 to 360 **and** 10 for 1 mark*

2

- (b) any **two** from:

more sweating (at 37.6 °C)

*'more' at least once in the first 2 points*

more water loss **or** dehydration occurs

*do **not** accept prevents dehydration only*

blood becomes (more) concentrated / (more) salty **or** need to replace water

stimulation of the hypothalamus

2

- (c) any **three** from:

evaporation

of water

*do **not** accept just water loss unqualified*

cools skin **or** uses heat from skin

cools blood / heat from blood (passing through skin)

*related to sweating  
cooling the blood  
ignore vasodilation*

3

[7]

### Q8.

- (a) (i) any **one** from:

- chemical messenger
- chemical / substance released in one part to have effect elsewhere in body
- chemical / substance which affects another / target organ / tissues / cells  
*allow chemical from endocrine gland*

1

- (ii) in blood / circulatory system / any named part including plasma  
*extra wrong answer would cancel example*  
**not** red blood cells

1

(b) **Quality of written communication:**

correct use of at least two relevant scientific terms spelt phonetically  
*e.g. pregnancy, ovulation, FSH, oestrogen, progesterone, ovary, follicle, circulation, thrombosis, feminisation, sperm count, STD*  
Q ✓ or Q ✗

1

any **three** from:

Oral contraceptives:

(benefit)

- prevent (unwanted) pregnancy **or** prevent egg release
- regulate menstrual cycle / periods

(problems)

- prolonged use may prevent later ovulation / cause infertility
- named side-effect on female body  
*e.g. circulatory problems / weight gain / nausea / headache / breast cancer / mood swings*
- increased promiscuity / increase in STD's / STI's
- named side-effect on environment  
*e.g. feminisation of fish **or** lowered sperm count in human males*

Fertility drugs:

(benefit)

- can enable woman to have children **or** to become pregnant  
**or** stimulates egg release

(problem)

- multiple births

*for full marks must score at least **one** re contraceptives **and** at least **one** re fertility drugs  
if unclear which type of hormone maximum **2** marks from 3*

**Q9.**

- (a) any **two** from:
- amylase / carbohydrase
  - protease  
*allow trypsin*
  - lipase
- 2
- (b) (i) high / above normal blood sugar  
**or** cannot control blood sugar  
*allow other symptoms*  
*eg frequent / plentiful urination **or** sugar in urine **or** thirst **or** weight loss **or** coma*  
*ignore consequential effects eg blood pressure / circulation / glaucoma / tiredness*
- 1
- (ii) any **one** from:
- small / regular meals
  - low sugar (meals) or low GI / GL **or** carbohydrates as starch  
*allow high fibre*  
*ignore reference to low carbohydrate*
- 1
- (iii) any **one** from:
- keep constant( blood) sugar **or** prevent high (blood) sugar  
**or** reduces surge / rush of sugar into blood
  - reduce the need for insulin
- 1
- (iv) (take) insulin  
*allow pancreas transplant*
- 1
- (c) protein / hormone / enzyme synthesis **or** synthesis of named example  
**or** combine amino acids
- 1

**Q10.**

- (a) (i) 6
- 1
- (ii) 4
- 1
- (b) (i) pancreas

*ignore islets of langerhans*

1

- (ii) 'X' anywhere between  $>1$  and  $\leq 2$  hours  
*anywhere in that column*

1

- (c) any **four** from:

water movement

*do **not** accept solution*

out of cells

dilute to concentrated solution

*accept reference to correct gradient -*

*high  $\Psi$  to low  $\Psi$  **or** high to low 'water concentration'*

*must be unambiguous – i.e. **not** 'high to low concentration'*

*accept low to high concentration*

reference to partially / selectively  
permeable membranes **or** described

cells shrink / get smaller

*allow crenated*

*ignore plasmolysed / flaccid / floppy*

*etc*

4

[8]

## Q11.

- (a) (i) receptor

*allow named receptor eg light receptor*

*ignore sensory neurone*

*allow sense organ / named sensory organ eg skin / eye*

1

- (ii) sensory (neurone)

*allow afferent*

1

- (iii) motor (neurone)

*allow efferent*

1

- (iv) effector / muscle / gland / named

1

- (b) any **two** from:

- impulse / information passes from one neurone to another  
**or** impulse / information passes across gap
- chemical / transmitter involved
- diffusion (across gap)

- (c) brain / person not aware of pain / stimulus / can't feel  
*allow brain/ person doesn't know / realise / unable to coordinate*  
*ignore reflex*  
*ignore information*

1

possibility of (permanent / serious) damage / eg burning  
*ignore danger*

1

**[8]****Q12.**

- (a) pancreas  
*allow phonetic spelling*

1

- (b) 4(.0) to 7.2 **or** 7.2 to 4(.0)

1

- (c)  $13 - 7 = 6$   
*working shows 6 = 1 mark*

1

$6/2 = 3$  units

*accept the correct answer to the calculation, 3 units, for 2 marks, irrespective of working*

1

increase (dose)

*accept indication of increase, eg extra / more / + could be in working lines*

1

**[5]****Q13.**

- (a) (i) any **one** from:
- chemical messenger / message  
*allow substance / material which is a messenger*
  - chemical / substance produced by a gland  
*allow material produced by a gland*
  - chemical / substance transported to / acting on a target organ
  - chemical / substance that controls body functions

1

- (ii) gland / named endocrine gland  
*brain alone is insufficient*  
*allow phonetic spelling*

1

(iii) in blood / plasma **or** circulatory system **or** bloodstream  
*accept blood vessels / named*  
*do **not** accept blood cells / named* 1

(b) *each hormone must be linked to correct action*  
*apply list principle*  
*ignore the gland producing hormone*

FSH stimulates oestrogen (production) / egg maturation / egg ripening  
*ignore production / development of egg* 1

oestrogen inhibits FSH  
*allow oestrogen stimulates LH / build up of uterine lining* 1

LH stimulates egg / ovum release / ovulation  
*accept LH inhibits oestrogen*  
*accept LH controls / stimulates*  
*growth of corpus luteum*  
*ignore production of egg* 1

[6]

**Q14.**

(a) (i) insulin  
*accept glucagon (correct spelling only)* 1

(ii) pancreas  
*accept phonetic spelling*  
*allow pancrease* 1

(b) (i) 11(.0)  
*accept in range 10.5-11 (.0)* 1

(ii) any **two** from:  
*ignore numbers unless comparative*

- high(er) concentration (of blood glucose) (anywhere / any time)  
*accept 115 not 88*  
*139 not 99*
- large(r) increase (in concentration after the drink)  
*accept increase by 24 not 11 / their b(i)*
- fast(er) / steep(er) rise  
*accept it takes 3 hours not 1 ¼ hours to get back to original level*  
*accept it takes a long time to get back to normal*
- slow(er) fall

(iii) any **one** from:

- insulin present / produced  
*accept glucagon not produced*
- (used in) respiration  
*allow exercise*
- taken into cells  
*allow converted to glycogen*  
*allow taken into liver (cells) / muscle (cells)*  
*allow produce / make energy*

1

[6]

### Q15.

(a) any **two** from:

- same result at pH 7 and 7.5  
**or**  
could be any pH between 7 and 7.5  
**or**  
not tested at pH 7.25  
**or**  
need to test at smaller pH intervals (between 7 and 7.5)
- accuracy of result only to nearest 0.5 minutes
- no repeats
- difficult to determine end point (colour)

2

(b) 2.7 / 5

1

0.54 (units per minute)

*allow 0.52 with no working shown for 2 marks*

1

*allow 1 mark for 0.52 **or** 0.56*

(c) (after 10 minutes) solution goes black

1

(after 60 minutes) solution stays the same

**or**

does not go black

**or**

goes slightly orange

1

(d) steeper curve

1

levels off at 11.8 units **and** before 45 minutes

1

(e) no / little sugar produced

*allow a correct description of what the graph would look like*

1



(because at 65 °C) the enzyme will be denatured  
*allow (because) the enzyme's shape will be changed*  
**or**  
*(because) the active site is damaged*

1

(so) will no longer fit the starch  
**or**  
(so) will not be able to catalyse the reaction

1

[11]

**Q16.**

(a) B

1

less / no insulin (produced) **or** insulin produced in pancreas  
*allow pancreas can't monitor (blood) sugar (level)*  
*ignore pancreas can't control (blood) sugar (level)*  
*allow increased glucagon production*  
*allow A as liver stores less glucose / sugar for 2 marks only*

1

(b) (i) (it / protein / insulin) digested / broken down  
*if ref to specific enzyme must be correct (protease / pepsin)*  
*ignore denatured*  
*do **not** accept digested in mouth / other incorrect organs*

1

(ii) any **two** from:  
*ignore injections*

- (attention to) diet  
*accept examples, eg eat less sugar(y food) **or** eat small regular meals*  
*allow eat less carbohydrate / control diet*  
*ignore cholesterol or balanced / healthy diet*

- exercise  
*ignore keep fit / healthy*

- (pancreas) transplant / stem cells / genetic engineering

2

[5]

**Q17.**

(a) Y - spinal cord / central nervous system / CNS

*do **not** accept spine*  
*ignore nerve / nervous system / coordinator*  
*ignore grey / white matter*

1

W - receptor / nerve ending

*ignore sensory / neurone / stimulus*

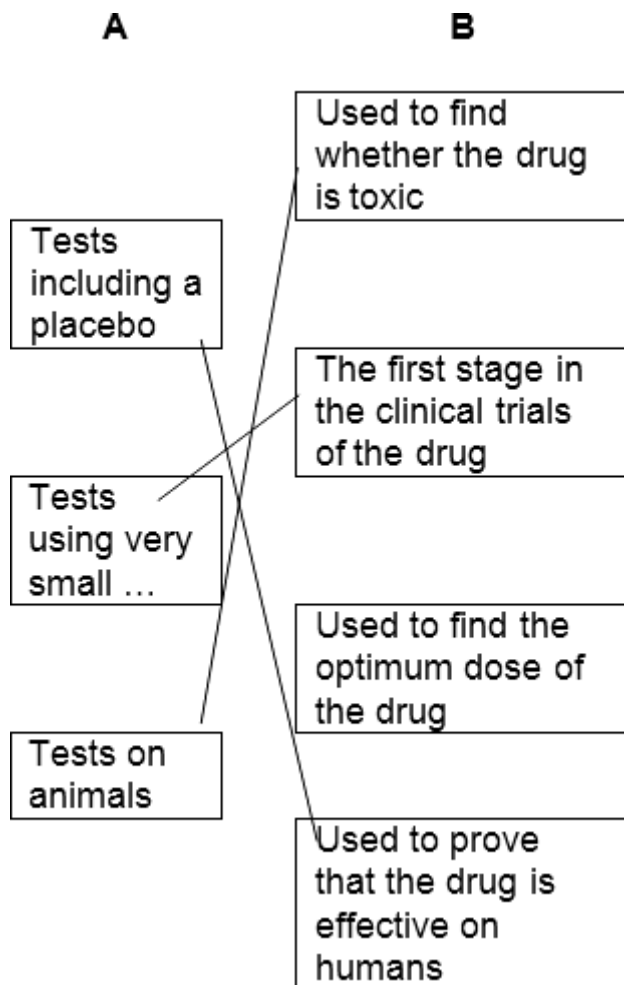
X - effector / muscle  
*allow gland*

(b) any **two** from: eg  
*accept reverse argument for each marking point*

- reflex action quicker
- effect of reflex action over shorter period
- hormone involves blood system and reflex involves neurones / nerve cells  
*ignore nervous system / nerves*
- reflex involves impulses and hormone involves chemicals
- reflex action affects only one part of the body  
*ignore involves brain*  
*ignore outside / inside stimuli*

**Q18.**

(a)



*1 mark for each correct line*  
*mark each line from left hand box*

(b) any **three** from:

*Students have been informed that the headline is not justified*

- reference to reliability, eg only a small number of mice tested  
**or** trial too short  
**or** investigation not repeated
- reference to control, eg mice given caffeine not coffee  
**or** 6 cups (equivalence) is more than 1 dose
- (and) the effect on mice might not be same as on humans  
*allow only tested on mice*
- (also) text suggests that the treatment improves memory loss (rather than delays it)  
*accept text suggests disease cured*

**or** mice already have memory loss or experiment only showed improvement in memory  
**or** does not show **delays** Alzheimer's  
**or** experiment not done on old mice  
*allow reference to the fact that mice engineered to have it*

3

[6]

**Q19.**

(a) homeostasis

1

(b) in sequence:

pancreas

1

liver

1

glycogen

*correct spelling only*

1

glucagon

*correct spelling only*

1

(c) (i) broken down / digested

1

further detail eg into amino acids / by enzymes / by proteases

1

(ii) diet / eating less sugar / less fat

*ignore balanced diet*

**or**

*ignore 'dieting' / slimming diet*

exercise

*accept pancreas transplant*

1

- (d) (i) sensible suggestion  
eg (owner's) smell / sweating / change in owner's behaviour / dizziness / tiredness

1

- (ii) any **five** from:

*allow 1 mark for justified conclusion*

*do not allow full marks unless at least 1 pro and 1 con.*

Pro:

- % below normal decreases
- % in normal increases
- reliable / repeatable / valid data as large number of samples  
*do not allow accurate / precise*
- patients express satisfaction.

Con:

- may not be reliable as blood glucose measurements for only 5 patients / survey of only 16 (dog owners)
- % above normal increases / dogs are less good at detecting high glucose.

5

- (e) glucose in urine of diabetic (and not in the non-diabetic)

1

urea and Na<sup>+</sup> ions are similar in each / slightly lower in diabetic

1

+ any **three** from:

- no protein in either urine sample because protein too large / does not pass through filter
- glucose passes through filter in kidney  
*ignore glucose is reabsorbed*
- non-diabetic: the / all glucose is reabsorbed / taken back into blood
- diabetic: (too much glucose so) cannot all be reabsorbed
- because diabetic has high concentration of glucose in blood
- urea and Na<sup>+</sup> lower in diabetic because less water is reabsorbed (due to extra glucose in filtrate).

3

[19]

## Q20.

- (a) person with muscle disease:

*allow reverse argument for healthy person*

any **three** from:

*NB all points are comparative except peak (point 3)*

*allow use of **two** approximate figures as a comparison*

- higher resting rate **or** higher at start
- when exercise starts / then increases more / more rapidly

*accept description eg rise .... fall*

- peaks (then falls)
- levels off later than healthy person
- higher rate during exercise  
*if no other marks awarded allow 1 mark for 'it's higher'*
- greater range

3

(b) (i) oxygen

*accept adrenaline*

*accept O<sub>2</sub>*

*do **not** accept O, O2 or O<sup>2</sup>*

1

(ii) cannot release sugar / glucose (from glycogen)

**or**

cannot store glucose / sugar (as glycogen)

1

need to receive glucose / sugar (from elsewhere)

*ignore oxygen*

1

for energy / respiration / cannot store energy

*ignore aerobic / anaerobic*

1

[7]

## Q21.

(a) detect changes in surroundings **or** detect stimuli

*allow any named stimulus for skin*

1

convert information to impulse

*allow send impulse to sensory neurones / brain*

1

(b) (i)

muscle	contract(ion)
gland	release / secrete / produce chemical / hormone / enzyme

*1 mark for each effector*

*1 mark for each response*

*response must match type of effector (if given)*

*ignore examples*

*ignore relax(ation) / movement for contraction*

do **not** allow expansion for muscles

4

(ii) any **one** from:

- (maintain temperature at which) enzymes work best
  - so chemical reactions are fast(est)
  - prevent damage to cells / enzymes
- allow prevent enzymes being denatured (by temperature being too high)*

1

[7]

**Q22.**

(a) (i) **A** – pituitary

*allow hypothalamus*

1

**B** – ovary / ovaries

1

(ii) in blood (stream)

*accept in plasma*

*ignore dissolved*

1

(b) (i) FSH and Luteinising Hormone (LH)

1

(ii) fertilised

OR

reference to sperm

1

form embryos / ball of cells or cell division

1

(embryo) inserted into mother's womb / uterus

*allow (fertilised egg) is inserted into mother's womb / uterus*

1

(iii) any **one** from:

- multiple births lead to low birth weight
  - multiple births cause possible harm to mother / fetus / embryo / baby / miscarriages
- allow premature*
- ignore reference to cost / ethics / population*

1

(c) (i) any **one** from:

- almost identical
- allow S (slightly) more successful*
- both approximately 20%

1

- (ii) larger numbers (in clinic R) (in 2007)  
*allow only 98 (in S) (compared to 1004 (in R))* 1
- results likely to be more repeatable (in 2008)  
*allow more reliable*  
*do **not** accept more reproducible / accurate / precise* 1

[11]

**Q23.**

- (a) (i) rate of chemical reactions (in the body) 1
- (ii) any **two** from:
- heredity / inheritance / genetics
  - proportion of muscle to fat **or** (body) mass  
*allow (body) weight / BMI*
  - age / growth rate
  - gender  
*accept hormone balance or environmental temperature*  
*ignore exercise / activity* 2
- (b) (i) 77  
*correct answer with or without working gains 2 marks*  
*allow 1 mark for 70 / 56 **or** 1.25 **or** 5* 2
- (ii) increase exercise  
*accept a way of increasing exercise* 1
- reduce food intake  
*accept examples such as eat less fat / sugar*  
*allow go on a diet **or** take in fewer calories*  
*ignore lose weight*  
*ignore medical treatments such as gastric band / liposuction* 1

[7]

**Q24.**

- (a) any **three** from:
- streamlined shape enables it to swim quickly (to catch fish)
  - wings (provide power) to move quickly (to catch fish)  
*allow 'flippers'*
  - wings used for steering
  - white underside / dark top acts as camouflage (so prey less likely to see it)
  - long / sharp beak to catch fish

3

(b) any **three** from:

- reduces (total) surface area of penguins exposed to wind / cold atmosphere
- reduced number of penguins exposed (to wind / cold)  
*accept reference to movement in or out of the huddle*  
*accept outer ones insulate / act as barrier*
- reducing heat loss  
*allow reduced cooling*
- 'share' body warmth / heat

3

(c) (i) any **two** from:

- size of tubes
- volume of (hot) water  
*accept amount of (hot) water*
- left for same length of time  
*allow measured at same time intervals*
- starting temperature

2

(ii) any **two** from:

- tube alone (**C**) lost heat most (rapidly)
- tube **B** intermediate
- tube **A** least (rapidly)  
*allow correct use of figures for all 3 tubes*  
*ignore just quoting final temperature*

2

(iii) confirms suggestion

*no mark awarded*

*accept correct answers referring to other suggestions in (b)*

since (both outer and inner) tubes in bundle lost heat less rapidly (than 'stand – alone' tube)

*comparison needed*

1

penguins in a huddle lose less heat (than single ones)

*accept 'it is the same for penguins'*

1

(d) **if the core body temperature is too high**

blood vessels supplying the skin (capillaries) dilate / widen

*accept reference to arteries / arterioles but **not** veins / capillaries*

*do **not** accept references to movement of blood vessels*

*ignore enlarge / expand*

*reference to skin / surface required only once*

1

so that more blood flows through the (capillaries) in skin / near surface

*reference to 'more' needed at least once to gain **2** marks*

1

and more heat is lost



reference to 'more' needed at least once to gain 2 marks

1

**if the core body temperature is too low**

blood vessels supplying the skin (capillaries) constrict / narrow

*allow full marks if 'too low' given first*

*if no other marks awarded, allow vasodilation when too warm*

***and** vasoconstriction when too cold for 1 mark*

1

- (e) (i) wings move to provide movement for diving

*allow muscles contract / work*

1

energy (for movement) comes from respiration

*do **not** allow produces / makes / creates energy*

*allow energy comes from / is supplied by / is released by  
respiration*

1

respiration / muscle contraction also releases heat

*allow produces heat*

1

- (ii) any **three** from:

- feet not / less used **or** no muscle contraction in feet

*allow little energy / heat released through respiration in feet*

*do **not** allow veins / capillaries*

- vessels supplying feet constrict / less blood to feet

- so temperature in feet cools / decreases

- more heat loss from large surface area or rapid flow of cold water over foot

3

[22]

**Q25.**

- (a) products below reactants

1

correct energy profile

1

activation energy correctly labelled

1

energy given out correctly labelled

1

- (b) 31 (%)

1

- (c) the products would be above the reactants

1

- (d) catalysts increase rate of reaction

*1 mark for each property*

*1 mark for each explanation*

so products formed in less time

**or**

catalysts lower activation energy

*explanation must be linked correctly to the property to gain the mark*

so lowers energy requirements

**or**

catalysts not used up in the reaction

so only an initial outlay needed

**or**

only a small amount of catalyst needed

so small initial cost

**max. 4**

(e) Protein

1

(f) high temperatures

1

extremes of pH

1

(g) lactase acts as the lock, lactose is the key (substrate)

1

lactase has an active site which will only fit lactose molecules

1

so lactase will not work with other molecules

1

**[16]**

**Q26.**

(a)  $0.92 = 76.2 \times \text{time}$

1

$\text{time} = 0.92 \div 76.2$

1

$= 0.012$

*allow 0.012 with no working shown for 3 marks*

1

(b) pathway **B** has two synapses

*allow converse for pathway **A***

1

chemicals diffuse across each synapse

1

which slows down the impulse

- (c) 140–203 1
- (d) use the same person for each test 1
- use left hand **and** right hand 1
- use a bigger sample size **or** more people  
*allow take more readings with each person* 1
- (e) mean drop distance =  $(230 + 211 + 279 + 215 + 264) \div 5 = 239.8$  1
- 239.8 mm = 0.2398 m 1
- mean reaction time =  $\sqrt{\frac{2 \times 0.2398}{9.8}}$  1
- = 0.221 1
- incorrect sig. figs max. 3 marks* 1
- allow 0.221 with no working shown for 4 marks* 1

[14]

**Q27.**

- (a) (i) chemical 1
- (ii) pituitary gland 1
- (b) 8 1
- allow 9 or 10*
- (c) (i) any **four** from: 4
- progesterone starts being produced at 4 weeks / no progesterone before 4 weeks
  - and then / from 4 weeks increases
  - oestrogen at constant / low level (from 0) to 20 weeks
  - and then / from 20 weeks increases
  - from 20 – 36 weeks level of O rises more steeply than that of P
- or**
- P is always higher than O from 6 to 36 weeks
- if no other marks awarded, allow progesterone and oestrogen both increase / rise for 1 mark.*
- (ii) oxytocin 1
- level of oxytocin increases just before birth 1

**Q28.**

- (a) tissue → organ → organ system  
*one right for 1 mark*  
*three right for 2 marks* 2
- (b) **Epithelial tissue** → covers the outside and the inside of the stomach  
*more than one line from a tissue = no mark* 1
- Glandular tissue** → produces digestive juices 1
- Muscular tissue** → allows food to be churned around the stomach 1
- (c) (i) light  
*ignore dark* 1
- (ii) moving (to the dark) 1
- (iii) any **two** from:
- use more woodlice
  - repeat the experiment
  - run for a longer time
- 2

[9]

**Q29.**

- (a) 6.1 circled on table (15 °C, test 1) 1
- (b) 1.8  
*do not allow 1.83* 1
- (c) 16 (minutes)  
*correct number extrapolated from curve* 1
- (d) 4.0 min – blue / black / purple 1
- 7.0 min – yellow / orange / brown 1
- (e) The amylase solution had been prepared with water at 95 °C 1
- (f) **Level 3 (5–6 marks):**  
 A clear and coherent method is described using logical steps and demonstrating a good understanding of how to improve the validity of the method. The method would lead to the production of valid results that would give rise to a more valid conclusion.

**Level 2 (3–4 marks):**

The substantive content of a method is present and demonstrates reasonable understanding of how to improve the validity but may be missing some detail. The plan may not be in a completely logical sequence but leads towards the measurement of rate of the reaction.

**Level 1 (1–2 marks):**

Simple relevant statements made, which demonstrate limited understanding of how to improve the experimental method. The response lacks logical structure and would not lead to the production of valid results or a more precise optimum temperature.

**0 marks:**

No relevant content

**Indicative content**

- conduct at a greater range of temperatures
- use temperatures both above and below 40 °C
- use smaller temperature intervals to get a more accurate optimum (eg go up in 2 °C increments)
- take samples at smaller time intervals to get a more accurate result for 'time taken'
- control the volume of starch used (eg 5 cm<sup>3</sup>)
- control the volume of the amylase solution (eg 1 cm<sup>3</sup>)
- control the temperature (eg using a water bath)
- heat the two solutions separately before mixing
- control the concentration of the starch solution
- control the concentration of the amylase solution

6

[13]

**Q30.**

- (a) fast reaction to reduce / protect from harm

*allow named examples*

1

- (b) higher caffeine concentration causes shorter reaction time.

*allow converse*

*ignore 'faster / slower reaction time'*

1

- (c) **Level 3 (5–6 marks):**

A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the collection of valid results.

**Level 2 (3–4 marks):**

The bulk of a method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

**Level 1 (1–2 marks):**

Discrete relevant points are made which demonstrate some understanding of the relevant scientific techniques and procedures. They may lack a logical structure and

would not  
lead to the production of valid results.

**0 marks:**

No relevant content.

**Indicative content**

- use decaffeinated coffee as control
- control volume of coffee
- blind trial or do not tell students which coffee they are drinking
- left for standard time between drink and test
- at least 10 minutes
- control start position of ruler
- control other factors such as light in the room
- same person for different concentrations
- repeat for each caffeine concentration
- use a range of caffeine concentrations
- start with lowest concentration of caffeine
- use caffeine solution instead of coffee to control for other ingredients
- repeat investigation with more people and calculate means

6

[8]

**Q31.**

(a) (i) any **three** from:

*if diet given as answer = max 2*

- age (of athlete)
- gender (of athlete)
- starting concentration of glycogen
- type / intensity of exercise
- length of exercise period
- number of training sessions

*if none of these points gained amount of exercise = 1 mark*

- time interval between exercise sessions
- exercise at same time of day

*if last four points not awarded allow time (for exercise) for 1 mark*

*ignore references to amount of energy  
ignore they are both athletes*

3

(ii) any **two** from:

- intensity of exercise
- amount of exercise between sessions
- starting concentration of glycogen
- fitness / health

- metabolic rate / respiration rate
- amount / mass of muscle / physique
- aspects of diet qualified, eg amount of food eaten  
*do **not** accept amount of carbohydrate*  
*if no other marks awarded allow height / mass / weight for 1 mark*

2

(iii) (B has) less glycogen  
*he = B*

**or** (B's glycogen) fell more  
*accept use of approximate figures*

**or** (B's glycogen) built up less  
*allow other correct observations from graph eg A is lower at end of first session*  
*ignore rate of fall*

1

(b) athlete **A** (no mark)  
*to gain full marks 'more' must be given at least once*

athlete **A** had more glycogen / **B** has less (only if A chosen to complete marathon)  
*accept converse argument for **B***

1

(glycogen / glucose) used in respiration  
*ignore anaerobic*

1

(more) energy released / available in athlete **A**  
*allow 'energy made'*

1

**and either** energy used for movement / muscle action / to run  
**or**  
(extra) glycogen → (more) glucose

1

[10]